

Trishna's

A Complete Guide to the

NTSE

National Talent Search Examination



FOR CLASS X

A Complete Guide to the

NTSE

(National Talent Search Examination)

for Class X

Trishna Knowledge Systems

A division of

Triumphant Institute of Management Education Pvt. Ltd.

PEARSON

Delhi • Chennai

**T.I.M.E.**Triumphant Institute of
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Preface

It is in the interest of the nation to identify and nurture the talent of its children for the future of the nation lies in their hands. Given the global competitive environment, it is important to identify and nurture them in their early years to enable them compete on the global stage.

To this end, the NCERT conducts the National Talent Search Examination (NTSE), India's most prestigious school level examination, for students studying in tenth standard, to identify students gifted with high intellectual prowess and reward them for their academic excellence.

Appearing for a national level competitive examination as the NTSE helps students arrive at an honest assessment of their analytical skills, and ability to apply the knowledge acquired in the classroom vis-a-vis students across the country. While those successful in the written test of this single stage examination are awarded financial scholarships by the NCERT, the bigger incentive is the prestige and honour associated with the recognition. In addition, a good performance in these tests will be a valuable credential embellishing one's profile. In fact the very process of preparation and appearing for these tests can be a very enriching experience simply because of the joy associated with learning something new about the world around us.

In order to excel in a highly competitive examination like the NTSE, one needs to thoroughly understand the fundamentals in each of the areas tested and prepare accordingly. This can be achieved only by a deeper understanding of the concepts involved, something which cannot be catered to in a regular school program for varying reasons.

Under the current pattern, the NTSE comprises two sections of equal weightage under multiple choice question format—Mental Aptitude Test (MAT), and Scholastic Aptitude Test (SAT). SAT tests a student's aptitude in Science, Mathematics, and Social Science, all of which are formally taught as a part of the regular school curriculum unlike the MAT section.

Given that MAT accounts for half the maximum score under the current pattern, it is of paramount importance that a student excels in this section as well to qualify. In addition, the pressure of answering questions with time constraint makes it all the more challenging and here comes the need for a strategy and an approach in keeping with the format of the examination. In the absence of a reliable resource addressing the above concerns, there has been a long-felt need for a book that helps students overcome these challenges.

A Complete Guide to the NTSE (National Talent Search Examination) for Class X has been prepared by **T.I.M.E. (Triumphant Institute of Management Education Pvt. Ltd.)**, the national leader in Test Prep segment and one of the biggest and the most successful classroom-based entrance examination training institutes in India. The book not only provides an exhaustive content for preparation for both MAT and SAT, but also, more importantly, helps students understand and adapt to the NTSE pattern. The book covers all topics comprehensively with numerous multiple choice questions. It also includes five full-length model papers on the lines of NTSE. Practicing these papers will provide a good insight to the level of preparation before the actual examination and will help fine-tune the preparation. This is the only book in the market which provides such an exhaustive topic-wise coverage along with mock papers.

For over two decades, **T.I.M.E.** has helped more than 10 lakh students achieve their goals. We train students for a wide variety of courses starting from the IIT-Foundation course for secondary school students to courses which help students gain entry to top management institutions in India and the world. We offer the IIT-Foundation course and preparatory course for school/board examinations for secondary school students. For students pursuing their 11th and 12th standards, we offer training for national level examinations like the IIT-JEE, AIEEE and for state level engineering and medical entrance tests. We train graduates for national level entrance examinations like the CAT, MAT, XAT, NIMCET, SNAP; international level examinations like the GRE, GMAT, TOEFL, IELTS and all major state level MBA/MCA entrance examinations.

The collective experience of the institute and its dedicated team, gained over the last two decades through training lakhs of students for a range of courses has meant that we can confidently say that nobody understands the needs of students and the nature of entrance examinations better than us.

A distinctive feature of this book is that it has been written by a team of experts. They are experienced in imparting the fundamentals of Mathematics, Science, Social Sciences and Reasoning to active learners at T.I.M.E. This book is a result of an in-depth study of previous NTSE papers and hence provides you that extra edge over the competition.

Wishing you success in your endeavour. For *in your success lies ours*.

The Editorial Team
Trishna Knowledge Systems

REASONING

PART 1

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Series and Analogies

Number and Letter Series form an important part of the Reasoning Section in various competitive examinations. There are two or three broad categories of questions that appear in various exams from this particular chapter.

In the first category of questions, a series of numbers/letters is given with one number/letter (or two numbers/letters) missing, represented by a blank or a question mark. The given series of numbers/letters will be such that each one follows its predecessor in a certain way, i.e., according to a definite pattern. Students are required to find out the way in which the series is formed and hence work out the missing number/numbers or letter/letters to complete the series. For the purpose of our discussion, we will refer to this category of questions as Number Series Type I or Letter Series Type I questions. Under Type I questions, there are a large variety of patterns that are possible and the student requires a proper understanding of various patterns to be able to do well in these types of questions.

In the second category of questions, a series of numbers/letters is given and the student is required to count how many numbers/letters in that series satisfy a given condition and mark that as the answer. For the purpose of our understanding, we will refer to this category of questions as Number Series Type II or Letter Series Type II questions. These questions will mainly involve counting of numbers/letters satisfying a given condition.

NUMBER SERIES – TYPE I

For better understanding, we will classify this into the following broad categories.

1. Difference series
2. Product series
3. Squares/Cubes series
4. Miscellaneous series
5. Combination series

Difference Series

The difference series can be further classified as follows.

- (a) Number series with a constant difference.
- (b) Number series with an increasing or decreasing difference.

In the number series with a **constant difference**, there is always a constant difference between two consecutive numbers. For example, the numbers of the series 1, 4, 7, 10, 13, are such that any number is obtained by adding a constant figure of 3 to the preceding term of the series.

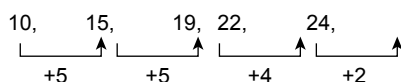
If we have to find the next number in the above series, we need to add a 3 to the last term 13. Thus, 16 is the next term of the series.

Under the series with constant difference, we can have series of odd numbers or series of even numbers also.

In the series with **increasing/decreasing difference**, the difference between consecutive terms keeps increasing (or decreasing, as the case may be). For example, let us try to find out the next number in the series 2, 3, 5, 8, 12, 17, 23,

Here, the difference between the first two terms of the series is 1; the difference between the second and third terms is 2; the difference between the third and the fourth terms is 3 and so on. That is, the difference between any pair of consecutive terms is one more than the difference between the first number of this pair and the number immediately preceding this number. Here, since the difference between 17 and 23 is 6, the next difference should be 7. So, the number that comes after 23 should be $(23 + 7) = 30$.

We can also have a number series where the difference is in decreasing order (unlike in the previous example where the difference is increasing). For example, let us find out the next term of the series 10, 15, 19, 22, 24,

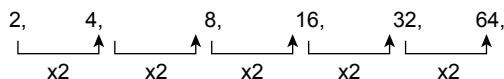


Here the differences between 1st and 2nd, 2nd and 3rd, 3rd and 4th numbers, etc., are 5, 4, 3, 2, and so on. Since the difference between 22 and 24 is 2, the next difference should be 1. So, the number that comes after 24 should be 25.

Product Series

A product series is usually a number series where the terms are obtained by a process of multiplication. Here also, there can be different types of series. We will look at these through examples.

Consider the series 2, 4, 8, 16, 32, 64,

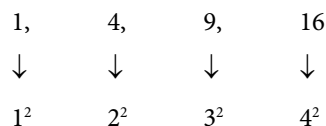


Here, each number in the series is multiplied by 2 to get the next term. So, the term that comes after 64 is 128. **So, each term is multiplied by a fixed number to get the next term.** Similarly we can have a series where we have numbers obtained by **dividing** the previous term with a constant number. For example, in the series 64, 32, 16, 8,, each number is obtained by dividing the previous number by 2 (or in other words, by multiplying the previous term by $\frac{1}{2}$). So, here, the next term will be 4 (obtained by dividing 8 with 2).

Squares/Cubes Series

There can be series where all the terms are related to the squares of numbers or cubes of numbers. With squares/cubes of numbers as the basis, there can be many variations in the pattern of the series. Let us look at various possibilities of series based on squares/cubes.

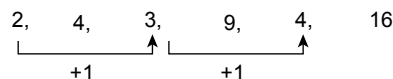
Each term of the series may be the square of a natural number, such as 1, 4, 9, 16,



The numbers are squares of 1, 2, 3, 4 respectively. The number which follows 16 (which is the square of 4) will be 25 (which is the square of 5).

The terms of the series may be the squares of odd numbers (for example, 1, 9, 25, 49,) or even numbers (for example, 4, 16, 36, 64,

The terms of the series could be such that a number and its square are both given one after the other and such pairs are given in some specific pattern. For example, take the series 2, 4, 3, 9, 4, 16,



Here, 2 is followed by its square 4; then comes the number 3 (which is one more than 2) followed by its square 9 and so on. Hence, the next number in the series is 5 and the one after that is its square i.e., 25.

Miscellaneous Series

There are series that do not come under the other patterns and are of general nature but are important and are fairly common. Even here, some times, there can be a specific pattern in some cases.

Take the series 3, 5, 7, 11, 13,

This is a series of consecutive PRIME NUMBERS. It is an important series and the student should look out for this as one of the patterns. The next term in this series is 17.

There can also be variations using prime numbers. Take the series 9, 25, 49, 121,

In this series, the terms are squares of prime numbers. Hence, the next term is 13^2 , i.e., 169.

Take the series 15, 35, 77,

The first term is 3×5 ; the second term is 5×7 ; the third term is 7×11 ; here the terms are product of two consecutive prime numbers. So, the next term will be the product of 11 and 13, i.e., 143.

Combination Series

A number series which has more than one type of (arithmetic) operation performed or more than one series combined together is a combination series. The series that are combined can be two series of the same type or could be different types of series as described above. Let us look at some examples.

First let us look at those series which are formed by more than one arithmetic operation performed on the terms to get the subsequent terms.

Consider the series: 2, 6, 10, 3, 9, 13, 4, 12, Here, the first term 2 is multiplied by 3 to get the second term, and 4 is added to get the third term. The next term is 3 (one more than the first term 2) and it is multiplied by 3 to get 9 (which is the next term) and then 4 is added to get the next term 13. The next term 4 (which is one more than 3) which is multiplied with 3 to get 12. Then 4 is added to this to get the next number 16.

Consider the series: 1, 2, 6, 21, 88, Here, we can observe that 88 is close to 4 times 21. It is in fact $21 \times 4 + 4$. So, if we now look at the previous term 21, it is related to the previous term 6 as $6 \times 3 + 3$. Now we get the general pattern: to get any term, multiply the previous term with k and then add k where k is a natural number with values in increasing order from 1. So, to get the second term, the first term has to be multiplied with 1 and then 1 is added. To get the third term, the second term is multiplied with 2 and then 2 is added and so on. Hence, after 88, the next term is $88 \times 5 + 5$, i.e., 445.

Now, let us look at a series that is formed by combining two (or more) different series. The two (or more) series can be of the same type or of different types described above.

Consider the series: 8, 12, 9, 13, 10, 14, Here the 1st, 3rd, 5th, ... terms which are 8, 9, 10, form one series whereas the 2nd, 4th, 6th, etc., terms which are 12, 13, 14 form another series. Here, both series that are being combined are two simple constant difference series. Therefore the missing number will be the next term of the first series 8, 9, 10, ... which is equal to 11.

Consider the series: 0, 7, 2, 17, 6, 31, 12, 49, 20, Here, the series consisting of 1st, 3rd, 5th, terms (i.e., the series consisting of the odd terms) which is 0, 2, 6, 12, 20, ... is combined with another series consisting of 2nd, 4th, 6th, ... terms (i.e., the series consisting of the even terms) which is 7, 17, 31, 49, The first series has the differences in increasing order 2, 4, 6, 8, 10 and so on. The second series also has the difference in increasing order 10, 14, 18, Since, the last term 20 belongs to the first series, a number from the second series should follow next. The next term of the second series will be obtained by adding 22 to 49, that is 71.

Consider the series: 1, 1, 2, 4, 3, 9, 4, 16, Here, one series consisting of odd terms, which is 1, 2, 3, 4,

is combined with the series of even terms which is 1, 4, 9, 16, The first series is a series of natural numbers. The second series is the squares of natural numbers. Hence, the next term is 5.

Consider the series: 1, 1, 4, 8, 9, 27, Here, the series of squares of natural numbers is combined with the series of cubes of natural numbers. The next term in the series will be 4.

Consider the series: 2, 4, 5, 9, 9, 16, 14, ?, 20, Here, we have to find out the term that should come in place of the question mark. The odd terms form one series 2, 5, 9, 14, 20, ... where the difference is increasing. The differences are 3, 4, 5, 6, This series is combined with the series of even terms 4, 9, 16, where the terms are squares of numbers 2, 3, 4, Hence, the term that should come in place of the question mark is the next term of the second series which is 5^2 , i.e., 25.

A General Approach to Number Series

The best way of approaching the number series questions is to first observe the difference between terms. If the difference is constant, it is a constant difference series. If the difference is increasing or decreasing by a constant number, then it is a series with a constant increasing or decreasing difference. If there is no constant increasing or decreasing difference, then try out the product series approach. For this, first divide the second term with the first term, third with the second, and so on. If the numbers obtained are the same, then it is a product series. Alternatively, try writing each term of the series as a product of two factors and see if there is any pattern that can be observed. If still there is no inference, but the difference is increasing or decreasing in a rapid manner, then check out the square series. If the increase is very high, and it is not a square series, then try out the cube series.

If the difference is alternately decreasing and increasing (or increasing for some time and alternately decreasing), then it should most probably be a mixed series. Therefore test out the series with alternate numbers. If still the series is not solved, try out the general series.

NUMBER SERIES – TYPE II

In these types of questions, a series of numbers are given. These numbers need not (and very often, DO NOT) follow any specific pattern. The objective here is not to find out a missing term. The objective is to find out how many times a given condition is satisfied in the given series of numbers. So, basically, what is expected of the student is COUNTING the digits subject to the conditions given. Let us take a look at the couple of examples given below.

Solved Examples

1. In the following number sequence how many 4's are there that are immediately preceded by 6 and immediately followed by 5?

3 4 2 6 5 4 3 6 4 5 9 8 6 4 5 3 8 7 4 6 8 2 1 7 6 4 5 8
6 4 5 9 7 4 5

☞ **Solution:** In the given number sequence

3 4 2 6 5 4 3 6 4 5 9 8 6 4 5 3 8 7 4 6 8 2 1

1 2

7 6 4 5 8 6 4 5 9 7 4 5

3 4

There are four such 4's which are immediately preceded by 6 and immediately followed by 5.

2. In the following number sequence how many odd numbers are there that are immediately preceded by an odd number and immediately followed by an even number?

7 8 6 5 2 4 3 1 8 7 9 4 6 8 3 1 4 2 7 5 6 4 8 1 3 8 9 7
2 6 4 8 3 6 5 2

☞ **Solution:** In the given number sequence,

7 8 6 5 2 4 3 1 8 7 9 4 2 6 8 3 1 4 2 7 5 6 4

8 1 3 8 9 7 2 6 4 8 3 5 2

There are 7 odd numbers which are immediately preceded by an odd number and immediately followed by an even number.

LETTER SERIES - TYPE I

The questions here are similar to the questions in Number Series Type I. Instead of numbers we have letters of the alphabet given here. We have to first identify the pattern that the series of letters follow. Then, we have to find the missing letter based on the pattern already identified. In Number Series, we saw different patterns that the numbers in the series can follow - like squares, cubes. In letter series, obviously, patterns like squares, cubes will not be possible. In Letter Series, in general, we have a series with constant

or increasing or decreasing differences. The position of the letters in the English alphabet is considered to be the value of the alphabet in questions on Letter Series. Also, when we are counting, after we count from A to Z, we again start with A, i.e., we treat the letters as being cyclic in nature. Like in Number Series, in this type of Letter Series also, we can have a "combination" of series, i.e., two series are combined and given. We need to identify the pattern in the two series to find out the missing letter. Sometimes, there will be some special types of series also. Let us look at a few examples to understand questions on Letter Series.

Solved Examples

1. Find the next letter in the series

D, G, J, M, P, ____.

- (1) Q (2) R
(3) S (4) T

☞ **Solution:** Three letters are added to each letter to get the next letter in the series.

i.e., D^{+3} , G^{+3} , J^{+3} , M^{+3} , P^{+3} , S

$P + 3$ and $P = 16$ and $16 + 3 = 19$ and the 19th letter in the alphabet is S.

Choice (3)

2. Find the next letter in the series

A, B, D, H, ____.

- (1) L (2) N
(3) R (4) P

☞ **Solution:** Each letter in the given series is multiplied with 2 to get the next letter in the series.

$A \times 2 \Rightarrow 1 \times 2 = 2$ and the 2nd letter is B,

$B \times 2 \Rightarrow 2 \times 2 = 4$ and the 4th letter is D.

Similarly, $H \times 2 \Rightarrow 8 \times 2 = 16$ and the 16th letter is P.

Choice (4)

LETTER SERIES – TYPE II

The questions here are similar to those that we saw in Number Series Type II. Instead of a sequence of numbers given here we have a sequence of letters given. The letters

given in the sequence need not (and in most of the cases, do not) follow any order or pattern. The student is asked to count how many times a particular letter (or group of letters) satisfying some conditions occurs and mark that number as the answer choice. Let us take some examples.

Solved Examples

1. In the following sequence of letters how many vowels are immediately preceded by a vowel and immediately followed by a vowel?

cpeajebcsmatammfdadhcoauidepakseadfaje
afdc~~aa~~e~~k~~aaakaea

- (1) Three (2) Four
(3) Five (4) Six

👉 **Solution:** In the given letter sequence
cpeajebcsmajammfdadhcoauidepakseadfaje

1 2

afdc~~aa~~e~~k~~aaakaea

3 4 5 6

There are 6 vowels which are immediately preceded by a vowel and immediately followed by a vowel

Choice (4)

2. In the following letter sequence, how many instances are there in which a vowel is immediately preceded and immediately followed by a consonant?

spruatpghjtkpserplmijkmporkgluwrablhtupqm

- (1) Six (2) Five
(3) Seven (4) Eight

👉 **Solution:** In the given letter sequence
spruatpghjtkpserplmijkmporkgluwrablhtupqm

1 2 3 4 5 6

There are six instances where a vowel is immediately preceded and is followed by a consonant.

Choice (1)

LETTER SERIES – TYPE III

A series of letters is given with one or more missing letters. From the choices, the choice that gives the letters that go into the blanks has to be selected as the answer. In these types of questions, the series itself can be looked at as being basically composed of smaller groups of letters. Each of the smaller groups has a pattern of its own. There are different patterns that the groups are made of and the way the groups of letters are put together to form the series. With the help of examples, we will look at different types of questions that can come in this area. Please note that in these types of questions, the number of blanks in the series indicates the number of missing letters, i.e., every missing letter is represented by one blank.

The letters a, b and c, may be arranged in a cyclic order to form a group and then repeated to form a series. In typical questions, some letters of this series would be missing and you have to find the pattern of the series and choose the correct alternative from the choices given to complete the series. In such type of problems, it is always better to proceed from the choices by inserting the letters given in the choices so as to obtain a sequence of a particular pattern.

Or

One can count the number of letters in the entire series and then break it up into smaller groups. For example, if a series has 15 letters one can break the series into 5 groups of 3 letters each or 3 groups of 5 letters each and then look for a pattern.

Solved Examples

1. Given below is a sequence in which some letters are missing. From the choices, select the choice that gives the letters that can fill the blanks in the given sequence.

a _ b _ _ _ a a _ b c _ .

- (1) abcabc (2) abccba
(3) abccbc (4) ababcc

☞ **Solution:** Inserting the letters of choice (3), in place of the blanks, we get a series which is a a b c c a a b c c .

Hence, the missing letters in the sequence are abccbc.

Choice (3)

2. Given below is a sequence in which some letters are missing. From the choices select the one that contains in order, the letters that can fill the blanks in the given series.

a b _ _ a _ _ d _ b c _ a _ _ d

- (1) cdbcabbc (2) cdbcadbc
(3) cdbacdbc (4) cdabcbcd

☞ **Solution:** a b c d | a b c d | a b c d | a b c d

The given sequence is divided into four parts, each of four letters. The first letter in each part is a, the second letter in each part is b, the third letter in each part is c, and the fourth letter in each part is d. Hence, the missing letters in the sequence are cdbcadbc.

Choice (2)

Analogy means “similarity” or “similar relationship”. In questions on number or letter analogies, a pair, that has a certain relationship between them, is given. This number/letter pair is followed by a third number/letter. The student is expected to identify the relationship between the pair given and find out a FOURTH number such that the relationship between the third and the fourth is similar to the relationship that exists between the first and the second. (In some cases, it may not be the fourth one that has to be found out. The fourth one will be given and the student has to find out one of the other three, whichever is not given).

Number Analogies

Typical relationships between the numbers in a given pair can be any of the following:

- One number is a multiple of the other.
- One number is the square or square root of the other.
- One number is the cube or cube root of the other.
- The two numbers are squares of two other numbers which themselves are related. For example, the two numbers are squares of two consecutive integers or squares of two consecutive even integers or squares of two consecutive odd integers.
- The two numbers are such that they are obtained by subtracting a certain number from the squares or cubes of the two related numbers.
- The two numbers are such that they are obtained by adding a certain number to the squares or cubes of the two related numbers.
- The two numbers can be consecutive, even, odd or prime numbers.

Let us take a few examples and understand the questions on Number Analogies.

Solved Examples

1. Find the missing number.

25 : 36 :: 49 : _____.

- (1) 61 (2) 63
(3) 65 (4) 60

☞ **Solution:** When the numbers in the question are considered the students tend to consider 25 and 36 as squares of two consecutive natural numbers. But the answer choices does not consist of an answer suitable to the above logic. Hence, it

is important that, the student keeps the answer choices in view in arriving at the logic.

$$25 + 11 = 36$$

Similarly, $49 + 11 = 60$

Choice (4)

2. Find the missing number.

$$27 : 51 :: 83 : \underline{\hspace{1cm}}$$

(1) 102

(2) 117

(3) 123

(4) 138

☞ **Solution:** The given analogy can be written as $5^2 + 2 : 7^2 + 2 :: 9^2 + 2 : \underline{\hspace{1cm}}$.

5 and 7 are successive odd numbers.

Similarly, next odd number to 9 is 11 and $11^2 + 2 = 121 + 2 = 123$.

Choice (3)

Letter Analogies

The questions in this area are similar to Verbal Analogies. Here, the questions are based on the relationship between two groups of letters (instead of two words as in Verbal Analogies). Typically, three sets of letters are given followed by a question mark (where a fourth set of letters is supposed to be inserted). The student has to find the relation

or order in which the letters have been grouped together in the first two sets of letters on the left hand side of the symbol : and then find a set of letters to fit in place of the question mark so that the third and the fourth set of letters will also have the same relationship as the first and the second. The sequence or order in which the letters are grouped can be illustrated by the following examples.

Solved Examples

1. BDEG : DFGI :: HKMO : ____.

(1) ILNP

(2) JMOP

(3) JMOQ

(4) JNOQ

☞ **Solution:** Two letters are added to each letter to get the next letters in the analogy.

B	D	E	G;	Similarly,	H	K	M	O
+2	+2	+2	+2		+2	+2	+2	+2
D	F	G	I		J	M	O	Q

Choice (3)

2. ACDF : CGJN :: BEHI : ____.

(1) DJNQ

(2) DINQ

(3) DINR

(4) DHNQ

☞ **Solution:**

A	C	D	F;	Similarly,	B	E	H	I
+2	+4	+6	+8		+2	+4	+6	+8
C	G	J	N		D	I	N	Q

Choice (2)

VERBAL ANALOGIES

Here, the questions are based on relationship between two words. In these kind of questions three words are followed

by a blank space, which the student has to fill up in such a way that the third and the fourth words have the same relationship between them as the first and the second words have. The following examples help in understanding the concepts.

Solved Examples

1. Gum : Stick :: Needle : ____

- (1) Cloth
- (2) Prick
- (3) Taylor
- (4) Stitch

👉 **Solution:** Gum is used to stick and needle is used to stitch.

Choice (4)

2. Socks : Feet : ____ : Hands

- (1) Arms
- (2) Shirt
- (3) Gloves
- (4) Fingers

👉 **Solution:** Socks are worn on feet, similarly gloves are worn on hands.

Choice (3)

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 3: Complete the following series.

1. 13, 39, 118, 356, 1071, 3217, ____
 (1) 9656 (2) 6459
 (3) 6355 (4) 9651

2. $\frac{50}{500}, \frac{40}{1200}, \frac{30}{1500}, \frac{20}{1400}, \text{____}$
 (1) $\frac{10}{1000}$ (2) $\frac{100}{1900}$
 (3) $\frac{10}{900}$ (4) $\frac{10}{800}$

3. 10, 200, 3000, 40000, ____
 (1) 500000 (2) 400000
 (3) 50000 (4) 6000000

Directions for questions 4 and 5: In each of the following number series a wrong number is given. Find the wrong number.

4. 2785 922 303 94 25 2
 (1) 94 (2) 303
 (3) 922 (4) 25
5. 8200 10944 8747 10475 9164 10144
 (1) 9164 (2) 10475
 (3) 8747 (4) 10944

Directions for questions 6 and 7: In each of the following series two wrong numbers are given out of which one differs by a margin of 1 i.e., +1 or -1 and the other with a greater margin. From the choices choose the number that is differing by the greater margin. The first and the last number in the series are always correct.

6. 1, 2, 7, 21, 88, 445, 2673, 18739
 (1) 7 (2) 21
 (3) 445 (4) 2673
7. 2, 10, 30, 65, 130, 222, 349, 520
 (1) 10 (2) 30
 (3) 349 (4) 65

Directions for questions 8 and 9: In each of these questions, a number series is given. After the series, a number is given along with (a), (b), (c), (d) and (e). You have to

complete the series starting with the number given to find the values of (a), (b), (c), (d) and (e) applying the same pattern followed in the given series. Then answer the question given below.

8. 10, 11, 101, 111, 1011, 1101
 1101, (a), (b), (c), (d), (e)
 What is the value of (d) in the series?
 (1) 11011 (2) 10111
 (3) 11101 (4) 1101
9. 7, 9, 18, 21, 63, 67, 268
 (a), (b), (c), (d), 39, (e)
 What is the value of (b) in the series?
 (1) 3 (2) 10
 (3) 5 (4) 12

Directions for questions 10 and 11: Each questions contains a number series one of the number is a wrong number. Find out the wrong number and form a new series starting with the wrong number and using the pattern in the given series. Answer the questions based on the new series.

10. 7, 21, 66, 138, 420, 846
 What is the fifth term of the new series?
 (1) 1098 (2) 3652
 (3) 924 (4) 512
11. 5, 7, 12, 15, 60, 65
 What is the fourth term in the new series?
 (1) 19 (2) 125
 (3) 20 (4) 382

Directions for questions 12 to 15: In each of the following questions, two rows of numbers are given. The resultant number of each row is to be worked out separately based on the following rules and the question below the row of numbers is to be answered. The operations of numbers progress from left to right.

Rules:

- (i) If an odd number is followed by a composite odd number, they are to be multiplied.
- (ii) If an even number is followed by an odd number, they are to be added.
- (iii) If an even number is followed by a number, which is a perfect square, the even number is to be subtracted from the perfect square.

- (iv) If an odd number is followed by a prime number, the first number is to be divided by the second number.
- (v) If an odd number is followed by an even number, the second one is to be subtracted from the first one.

12.	14	196	23
	10	x	152

If x is the resultant of the first row, what is the resultant of the second row?

- (1) 367 (2) 91
(3) 63 (4) 105

13. 65	5	9
109	24	5

What is the difference between the resultants of the two rows?

- (1) 5 (2) 90
(3) 17 (4) 100

14.	42	7	76
	10	p	5

If p is the resultant of the first row, what is the resultant of the second row?

- (1) 10 (2) 12
(3) 20 (4) 30

15.	7	9	2
	3	2	15

What is the difference between the resultants of the two rows?

- (1) 26 (2) 75
(3) 20 (4) 10

Directions for questions 16 to 19: Complete the following series.

16. GKF, IPC, LTY, PWT, UYN, _____

- (1) ABZ (2) XBZ
(3) XAH (4) AZG

17. FTJMP, GRMIU, EUINO, _____, DVHON, IPOGW

- | | |
|-----------|-----------|
| (1) BYDTL | (2) HQNHV |
| (3) YNHAV | (4) HQDTL |

18. ATNHG, DKCMB, CVPJI, GNFPE, EXRLK, JQISH, GZTNM,

- (1) MTLVK (2) HSKUJ
(3) RIJTU (4) PQMTH

19. BC25, CE64, EG144, GK324, _____

- (1) HO529 (2) KM729
(3) HI289 (4) KM576

Directions for question 20: Select the correct alternative from the given choices.

20. In the following sequence of digits, how many digits are immediately preceded by a digit which is a multiple of 3 and immediately followed by a digit which is a multiple of 4?

7 3 2 4 6 8 9 3 5 7 8 4 3 2 1 5 6 3 8

- | | |
|-------|-------|
| (1) 5 | (2) 2 |
| (3) 4 | (4) 6 |

Directions for questions 21 to 24: These questions are based on the set of numbers given below.

417 258 193 624 275

21. If 1 is added to the first digit and 1 is subtracted from the last digit then which of the given numbers becomes the smallest number?

- (1) 417 (2) 258
(3) 193 (4) 624

22. If the first and the second digits are interchanged and then the new numbers so obtained are arranged in ascending order then which of given numbers take the second place from the right?

- (1) 417 (2) 258
(3) 193 (4) 275

23. If each number is written in reverse order and then the first and the third digits of the numbers so obtained are interchanged, then which of the given numbers becomes the second smallest number?

- (1) 462 (2) 264
(3) 642 (4) 426

24. If 1 is added to the middle digit and 1 is subtracted from the last digit and then the first and the second digits are interchanged, then which of the given numbers becomes the second smallest number?

- (1) 462 (2) 264
(3) 642 (4) 426

Directions for questions 25 to 28: Complete the following series.

25. 57, 60, 63, 66, 69, _____

- (1) 72 (2) 73
(3) 70 (4) 74

26. 12, 21, 39, 75, 147, _____

- (1) 273 (2) 291
(3) 283 (4) 263

27. 440, 360, 288, 224, ____

- (1) 170 (2) 169
(3) 168 (4) 171

28. 12, 30, 56, 132, 182, ____

- (1) 240 (2) 300
(3) 316 (4) 306

Directions for questions 29 to 35: Each of the following questions contain a pair of terms on the left side of (: :), which exhibit a certain relation between them. Find the term which exhibits similar relations with the word on the right side of (: :).

29. 324 : 342 :: 196 : ____

- (1) 218 (2) 210
(3) 222 (4) 234

30. 121 : 484 :: 235 : ____

- (1) 1350 (2) 2750
(3) 2150 (4) 2350

31. F : S :: L : ____

- (1) V (2) W
(3) X (4) Y

32. RISHLE : IVHSOR :: PUBLIC : ____

- (1) KHVPWY (2) KHYOVX
(3) KIXPWZ (4) KHXNVY

33. MTSRA : OWXYL :: MNRLIH : ____

- (1) OQVTVW (2) OQUVRW
(3) OQTPST (4) OQWSTU

34. PSB : NRQUZD :: SET : ____

- (1) RTDFSU (2) QUCGRV
(3) QUDFRU (4) QUCGSV

35. DEPRL : LRPED :: POCKET : ____

- (1) TECHOP
(2) TEKOCB
(3) TEKOP
(4) TELNOQ

Directions for question 36: In the English alphabet, the order of the letters in the first half is reversed and written from left to right. Answer the following question based on the above sequence.

36. H : S :: C : ____

- (1) P (2) Q
(3) T (4) R

Directions for questions 37 to 40: Each of the following questions contain a pair of terms on the left side of (: :), which exhibit a certain relation between them. Find the term which exhibits similar relations with the word on the right side of (: :).

37. D8 : F12 :: K22 : ____

- (1) M13 (2) M26
(3) Q34 (4) P32

38. 6R3 : 8N2 :: 2P3 : ____

- (1) 1L2 (2) 4L2
(3) 2K2 (4) 2L4

39. Pig : Piglet :: Dog : ____

- (1) Cat (2) Tail
(3) Pug (4) Puppy

40. Kangaroo : Hopping :: Snake : ____

- (1) Crawling (2) Mongoose
(3) Poisonous (4) Bite

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 4: Complete the following series.

1. 29, 29, 27, 23, 25, 19, 23, 17, ____, ____

- (1) 19, 13 (2) 19, 15
(3) 21, 13 (4) 19, 13

2. 5, 12, 13, 7, 14, 17, 9, 16, 19, 11, 18, 23, ____, ____

- (1) 25, 27, 25 (2) 20, 25, 27
(3) 17, 23, 29 (4) 13, 20, 29

3. $\frac{5}{7}, \frac{11}{13}, \frac{17}{19}, \frac{23}{29}, \text{____}$

- (1) $\frac{31}{33}$ (2) $\frac{31}{35}$
(3) $\frac{31}{37}$ (4) $\frac{33}{37}$

4. 2, 4, 6, 4, 6, 10, 6, 8, 14, 8, 10, 18, ____, ____, ____

(1) 10, 11, 110
(2) 9, 10, 19
(3) 10, 11, 21
(4) 10, 12, 22

Directions for questions 5 and 6: In each of the following number series a wrong number is given. Find the wrong number.

5. 40000 10500 2500 625 156.25 39.0625

(1) 2500 (2) 10500
(3) 625 (4) 156.25

6. 671 695 678 802 795 809 792 816 799

(1) 799 (2) 678
(3) 802 (4) 795

Directions for questions 7 and 8: In each of the following series two wrong numbers are given out of which one differs by a margin of 1 i.e., +1 or -1 and the other with a greater margin. From the choices choose the number that is differing by the greater margin. The first and the last number in the series are always correct.

7. 1, 4, 15, 64, 260, 1024, 4096, 16384

(1) 1024 (2) 64
(3) 15 (4) 260

8. 15120, 7560, 2525, 630, 126, 20, 3

(1) 7560 (2) 2525
(3) 630 (4) 126

Directions for questions 9 to 14: In each of these questions a number series is given. After the series, a number is given along with (a), (b), (c), (d) and (e). You have to complete the series starting with the number given to find the values of (a), (b), (c), (d) and (e) applying the same pattern followed in the given series. Then answer the question given below.

9. 0, 6, 24, 60, 120, 210

210, (a), (b), (c), (d), (e)

What is the value of (b) in the series?

(1) 720 (2) 623
(3) 512 (4) 504

10. 1, 3, 11, 47, 239, 1439

(a), (b), (c), (d), (e), 2159

What is the value of (a) in the series?

(1) 1×5 (2) 2
(3) 3 (4) 4

11. 15, 30, 39, 96, 99, 198, 200, 600

What is the third term in the new series?

(1) 400 (2) 796
(3) 76 (4) 80

12. 7, 9, 13, 21, 40, 69, 133

What is the fifth term in the new series?

(1) 49 (2) 86
(3) 70 (4) 142

13. 143 11 8

12 36 3

What is the sum of the resultants of the two rows?

(1) 64 (2) 42
(3) 32 (4) 80

14. 64 55 17

81 32 2t

If t is the resultant of the first row, what is the resultant of the second row?

(1) 9 (2) 7
(3) 56 (4) 35

Directions for questions 15 and 16: In each of the following questions, two rows of numbers are given. The resultant number of each row is to be worked out separately based on the following rules and the question below the rows of numbers is to be answered. The operation of numbers progress from left to right.

Rules:

- If an even number is followed by a composite odd number, then the first number is to be subtracted from the second number.
- If an odd number is followed by a prime number, then the numbers are to be added.
- If an odd number is followed by an even number, then the numbers are to be added.
- If an even number is followed by a prime number then the even number is to be divided by the prime number.
- If an even number is followed by an even number, then the first number is to be subtracted from the second number.
- If an odd number is followed by a composite odd number, then the numbers are to be multiplied.

15. 17 8 13

19 17 r

If r is the resultant of the first row, what is the resultant of the second row?

(1) 48 (2) 100
(3) 85 (4) None of these

25. 24 : 576 :: 32 : _____
 (1) 1024 (2) 992
 (3) 1228 (4) 865
26. 3864 : 5098 :: 4994 : _____
 (1) 6228 (2) 6246
 (3) 6194 (4) 6286
27. 512 : 504 :: 1728 : _____
 (1) 1728 (2) 1716
 (3) 1718 (4) 1724
28. 7 : 18 :: 12 : _____
 (1) 26 (2) 28
 (3) 32 (4) 37
29. 3829 : 3851 :: 2987 : _____
 (1) 3013 (2) 3007
 (3) 3017 (4) 3023
30. K : P :: S : _____
 (1) F (2) H
 (3) G (4) I
31. NATURE : PEVASI :: ISOMERS : _____
 (1) OTUNJTV (2) OTU
 (3) PUVNJST (4) OVT
32. FIELD : LRJXH :: CRICKET : _____
 (1) FHRDXLJ (2) FJPD
 (3) FJRDAL (4) FJRF
33. LDCBE : LHIHY :: FKGEA : _____
 (1) FXTXB (2) FVT
 (3) FVUTE (4) FTV
34. MARINE : AIENRM :: DISGUISE : _____
 (1) IGIEDSUS (2) IDGS
 (3) IGESRNPO (4) IGIE

35. BCE : DIY :: ADFG : _____

- (1) APLV
- (2) APIW
- (3) AIPW
- (4) APJW

Directions for question 36: In the English alphabet, the order of the letters in the first half is reversed and written from left to right. Answer the following questions based on the above sequence.

36. EKT : BHW :: RIL : _____

- (1) UHJ
- (2) UFI
- (3) ULP
- (4) UHN

Directions for questions 37 to 40: Each of the following questions contain a pair of terms on the left side of (: :), which exhibit a certain relation between them. Find the

term which exhibits similar relations with the word on the right side of (: :).

37. B6H : D10N :: K5P : _____

- (1) M9V
- (2) T72
- (3) R8J
- (4) B6D

38. BCD : 234 :: _____ : 678

- (1) CDE
- (2) EFG
- (3) GHF
- (4) FGH

39. Nut : Shell :: Seed : _____

- (1) Plant
- (2) Tree
- (3) Fruit
- (4) Sapling

40. USA: President :: Germany : _____

- (1) Berlin
- (2) Chancellor
- (3) Director
- (4) Arms

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 1	2. 3	3. 1	4. 2	5. 1	6. 4	7. 4	8. 3	9. 3	10. 3
11. 1	12. 3	13. 4	14. 2	15. 4	16. 4	17. 2	18. 1	19. 4	20. 2
21. 3	22. 4	23. 2	24. 4	25. 1	26. 2	27. 3	28. 4	29. 2	30. 4
31. 4	32. 2	33. 4	34. 2	35. 3	36. 4	37. 2	38. 2	39. 4	40. 1

PRACTICE EXERCISE 1 (B)

1. 3	2. 4	3. 3	4. 4	5. 2	6. 4	7. 4	8. 2	9. 4	10. 2
11. 4	12. 3	13. 3	14. 4	15. 4	16. 4	17. 1	18. 4	19. 3	20. 1
21. 4	22. 1	23. 2	24. 4	25. 1	26. 1	27. 2	28. 2	29. 1	30. 2
31. 2	32. 4	33. 3	34. 4	35. 4	36. 2	37. 1	38. 4	39. 3	40. 2

Odd Man Out, Coding and Decoding

Finding the odd man out from the given alternatives is a very common type of questions that one comes across in different competitive examinations. In the questions on odd man out, all the items-except one-follow a certain pattern (in their formation) or belong to a group. The item that does not follow the pattern or does not belong to the group has to be marked as the answer choice.

The problems of this variety often fall under the category of CLASSIFICATION. When a given set of elements is classified under a single head, one of the items will not fall into that group to which the rest belong, i.e., it will not have the common property, which the others will have. Hence it becomes the odd man out.

Questions on classification can be asked in any form. Some of the commonly asked ones are given below.

(1) ALPHABET CLASSIFICATION

In this type, a group of jumbled letters typically consisting of three letters, (but can be four or two or just a single letter) are put together. The pattern or order in which they are grouped is to be studied and we need to find out which groups have the same pattern or relationship between the letters. There will be one choice, which will have a pattern different from the rest and that is our answer.

Solved Examples

1. Find the odd one among the following.

- (1) ZW
- (2) TQ
- (3) SP
- (4) NL

👉 **Solution:** $Z^{-3}W$, $T^{-3}Q$, $S^{-3}P$, $N^{-2}L$, $P^{-3}M$

Hence, NL is the odd one.

Choice (4)

2. Find the odd one among the following.

- (1) CFD
- (2) GJH
- (3) KNM
- (4) JMK

👉 **Solution:** $C^{+3}F^{-2}D$, $G^{+3}J^{-2}H$, $K^{+3}N^{-1}M$, $J^{+3}M^{-2}K$, $V^{+3}Y^{-2}W$

Hence, KNM is the odd one.

Choice (3)

(2) WORD CLASSIFICATION

Here, different items are classified based on common properties like names, places, professions, parts of speech, etc. A few examples are illustrated below.

Solved Examples

3. Find the odd one among the following.

- (1) Mercury
- (2) Moon
- (3) Jupiter
- (4) Saturn

☞ **Solution:** All others except Moon are planets whereas Moon is a satellite.

Choice (2)

4. Find the odd one among the following.

- (1) SORE (2) SOTLU
- (3) NORGAE (4) MEJNIAS

☞ **Solution:** The words are jumbled. The actual words are ROSE, LOTUS, ORANGE, JASMINE and LILLY. All, except ORANGE, are flowers whereas ORANGE is a fruit.

Choice (3)

(3) NUMBER CLASSIFICATION

In this case, we need to choose the odd number from the given alternatives. The numbers may belong to a particular set, i.e., they may be odd, even, prime, rational, squares,

cubes, and they may also be coded into binary digits (involving 0's and 1's) etc. and only one of the choices will not follow the rule which others do and that is our answer. A few illustrations are given below.

Solved Examples

5. Find the odd one among the following.

- (a) (1) 17 (2) 27
- (3) 37 (4) 47
- (b) (1) 441 (2) 289
- (3) 361 (4) 343
- (c) (1) 1011 (2) 1101
- (3) 1111 (4) 10001

☞ **Solution:**

(a) All the given numbers except 27 are prime numbers whereas 27 is a composite number.

Choice (2)

(b) The given numbers can be written as $(21)^2$, $(17)^2$, $(19)^2$, $(7)^3$, $(25)^2$ All except 343 are the squares whereas 343 is a cube.

Choice (4)

(c) The given numbers are in binary system, converting these into the decimal system we get, 1011

$$\Rightarrow 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\ = 8 + 2 + 1 = 11$$

$$1101 \Rightarrow 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \\ = 8 + 4 + 1 = 13$$

$$1111 \Rightarrow 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\ = 8 + 4 + 2 + 1 = 15$$

$$0001 \Rightarrow 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \\ = 16 + 1 = 17$$

$$111 = 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\ = 4 + 2 + 1 = 7$$

All the given numbers except 15 are prime numbers.

Choice (3)

Before looking at the different types of questions and some of the codes that can be used with the help of examples, let us first understand what we mean by *coding* and *decoding*. When we say *coding*, a particular code or pattern is used to express a word in English language as a different word or in a different form. The coded word itself does not make any sense unless we know the pattern or code that has

been followed. *Decoding* refers to the process of arriving at the equivalent English word from the code word given.

In the questions, a particular code is given and on the basis of this given code, we have to find out how another word (in English language) can be coded. The correct code for the given word has to be selected from the answer choices on the basis of the code given in the question.

Solved Examples

1. In a certain code language, if the word 'PARTNER' is coded as OZQSM DQ, then what is the code for the word 'SEGMENT' in that language?

- (1) TFHNFOU
- (2) RDFLDMS
- (3) RDELDMS
- (4) RDFEDNS

☞ **Solution:**

Word : P A R T N E R
 Logic : -1 -1 -1 -1 -1 -1
 Code : O Z Q S M D Q
 Similarly the code for SEGMENT is
 Word : S E G M E N T
 Logic : -1 -1 -1 -1 -1 -1
 Code : R D F L D M S

Choice (2)

2. In a certain code language, if the word RECTANGLE' is coded as TGEVCPING, then how is the word 'RHOMBUS' coded in that language?

- (1) TJOQDWV
- (2) TJQNDWU
- (3) TJQODWU
- (4) TJQOEWU

☞ **Solution:**

Word : R E C T A N G L E
 Logic : +2 +2 +2 +2 +2 +2 +2 +2
 Code : T G E V C P I N G
 Similarly, the code for RHOMBUS is
 Word : R H O M B U S
 Logic : +2 +2 +2 +2 +2 +2 +2
 Code : T J Q O D W U

Choice (3)

Directions for questions 3 to 6: In a certain code language, the codes for some words are as follows.

NATION	-	agvnab
REMOTE	-	rzgrbe
STAIR	-	efgnv
FORMAL	-	bensyz
COMMON	-	zabzpb
FOR	-	ebs

Based on the above coding pattern answer the following questions.

3. What is the code for 'SCREEN'?
 (1) fepcra (2) fpersa
 (3) fpreba (4) fperra
4. What is the code for 'RATION'?
 (1) ensvba (2) engvba
 (3) engrba (4) engvca
5. What is the code for 'CREATOR'?
 (1) prengbc
 (2) persbgc
 (3) perngbe
 (4) pebryc
6. What is the code for 'AMERICAN'?
 (1) nzrevpna
 (2) nzrespna
 (3) nzlespna
 (4) nzreqpna

☞ **Solutions for questions 3 to 6:**

The given words and their codes are as follows:

(1) NATION	-	agvnab
(2) REMOTE	-	rzgrbi

- (3) STAIR - efgnv
- (4) FORMAL - bensyz
- (5) COMMON - zabzpb
- (6) FOR - ebs

In the first word, the letter N is repeated and so is the code a. Hence, for N, the code is a. Similarly, from the second word, the code for E is 'r'. In first and sixth words the letter o is common and so is the code b. Hence, the code for o is b. In the fifth word, the letter m is repeated and so is the code z. Hence, the code for m is z. Similarly, the codes for the remaining letters can be determined.

The letters and their respective codes are as follows:

Letter	A	C	E	F	I	L	M	N	O	R	S	T
Code	n	p	R	s	v	y	z	a	b	e	f	G
letter												

- 3. The code for 'SCREEN' is fperra.
Choice (4)
- 4. The code for 'RATION' is engvba.
Choice (2)
- 5. The code for 'CREATOR' is perngbe.
Choice (3)
- 6. The code for 'AMERICAN' is nzrevpna.
Choice (1)

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 24: In each of the following questions, three out of the following four are alike and hence form a group. Find the one which does not belong to that group.

- | | |
|---|--|
| <p>1. (1) 27 (2) 37
(3) 47 (4) 67</p> <p>2. (1) 36 (2) 49
(3) 64 (4) 81</p> <p>3. (1) 343 (2) 121
(3) 1331 (4) 2197</p> <p>4. (1) $\frac{2}{22}$ (2) $\frac{5}{55}$
(3) $\frac{1}{1}$ (4) $\frac{3}{33}$</p> <p>5. (1) 508 (2) 328
(3) 608 (4) 148</p> <p>6. (1) PMS (2) ROU
(3) GDJ (4) KIM</p> <p>7. (1) GFI (2) QOR
(3) LKN (4) YXA</p> <p>8. (1) KMNL (2) PRSQ
(3) VWYZ (4) JLMK</p> <p>9. (1) OQMS (2) UAWY
(3) NPLR (4) BDZF</p> <p>10. (1) B4 (2) E25
(3) D16 (4) I91</p> <p>11. (1) Chameleon (2) Crocodile
(3) Turtle (4) Allegator</p> <p>12. (1) Part (2) Trap
(3) Cart (4) Dart</p> <p>13. (1) Skin (2) Eye
(3) Leg (4) Nose</p> <p>14. (1) Baseball (2) Boxing
(3) Chess (4) Wrestling</p> <p>15. (1) HEWAT (2) CERI
(3) ROWAJ (4) EECRALS</p> | <p>16. (1) 8 (2) 27
(3) 64 (4) 125</p> <p>17. (1) Trapezium (2) Square
(3) Triangle (4) Cube</p> <p>18. (1) Lungs (2) Eyes
(3) Fingers (4) Ears</p> <p>19. (1) Oasis (2) Fountain
(3) Mirage (4) Pond</p> <p>20. (1) India : Rupee (2) America : Dollar
(3) Kuwait : Dinar (4) Australia : Pound</p> <p>21. In a certain code language, if the word CUSTOMER is coded as RCEUMSOT, then how is the word IM-MACULATE coded in that language?
(1) EITMMALAUC (2) EITMAMLAUC
(3) ETEMAMALUC (4) EITMMALUAC</p> <p>22. In a certain code language, if the word SEARCH is coded as IDSBFT, then how is the word FURNISH coded in that language?
(1) ITKNSVG (2) ITJORWG
(3) ITJOSVG (4) ITHNRVG</p> <p>23. In a certain code language, if the word BARRICADE is coded as AABCDEIRR, then how is the word IN-DIVIDUAL coded in that language?
(1) ADDIILNUV (2) ADDIINLUV
(3) AIIUDDLNV (4) ADDINIILUV</p> <p>24. In a certain code language, if INFER = 25 and JERSEY = 28, then CHOICE = ?
(1) 34 (2) 39
(3) 41 (4) 47</p> <p>Directions for questions 25 and 26: These questions are based on the following data.</p> <p>In a certain code language, if the word ROUTINE is coded as JMPRRLJ and the word FIDELITY is coded as LGHCXGNW, then how will you code the following words in that language?</p> <p>25. TOBACCO
(1) NMDXEAF (2) NMDYEBF
(3) NMCYFBD (4) NMDYFAD</p> |
|---|--|

26. In a certain code language, the word INDUSTRY is coded as $C_3 G_2 B_2 C_7 S_1 D_5 F_3 E_5$ and the word CREDIT is coded as $C_1 F_3 E_1 B_2 C_3 D_5$, then find the code for MOTIVE.

- (1) $M_1 C_5 D_4 C_3 K_2 E_1$ (2) $M_1 E_3 J_2 C_3 K_2 E_1$
 (3) $M_1 E_4 D_5 C_3 T_2 E_1$ (4) $M_1 E_4 J_2 C_4 K_2 E_2$

Directions for question 27: For the following groups of letters given in Column I, the codes are given in Column II. Answer the following questions by finding the codes for the groups from the given columns.

Column I	Column II
(1) lit kit bit dit	b r p d
(2) fit git mit kit	t d s v
(3) rit bit git tit	x p v w
(4) nit dit fit rit	r s x j

27. What is the code for nit?

- (1) x (2) s
 (3) j (4) r

Directions for question 28: For the words given in column I, the codes are given in Column II. Answer the following questions by finding the codes for the letters from the words and their codes given in the columns.

Column I	Column II
(1) PRETEND	4396408
(2) COMMON	615715
(3) HOUSE	4*2&1
(4) SUPPORT	3*21839
(5) DRUM	5*08

28. What is the code for the word HORMONE?

- (1) &385364 (2) &176561
 (3) &175184 (4) &185164

Directions for questions 29 and 30: For the following sentences given in column I, the codes are given in column II. Answer the following questions by finding the codes for the words from the given columns.

Column I	Column II
All people are not poet	kak cac hah faf zaz
Great people are happy	tat dad faf zaz
Krishna is a god	nan gag rar mam
Tagore is a great poet	mam kak dad nan lal
God make people happy	tat gag faf sas
No person is happy	xax pap faf mam

29. What is the code for the word 'Tagore' in that language?

- (1) kak (2) dad
 (3) lal (4) nan

30. Which of the following can be the code for "Tagore make great paintings" in that language?

- (1) dad sas lal cac (2) lal kak zaz waw
 (3) qaq lal gag sas (4) lal dad sas vav

Directions for questions 31 and 32: For the following sentences given in column I, the codes are given in column II. Answer the following questions by finding the codes for the words from the given columns.

Column I	Column II
I do not cheat.	1 # 2 7
I win the gold medal	9 @ 7 6 Ψ
I am not the last	3 7 6 π #
Manav do not loose	1 8 # %
Last person win the silver medal	4 π 6 θ @ Ψ
Manav is a person	4 5 8 *

31. What is the code for 'cheat'?

- (1) 7 (2) 1
 (3) # (4) 2

32. What is the code for "Manav is a cheat"?

- (1) * 8 # 5 (2) 4 8 5 2
 (3) 5 * 8 2 (4) 5 9 4 2

Directions for questions 33 and 34: Given below are the codes for the digits/symbols. Study the conditions given below and answer the questions that follow.

Digit/ symbol:	6 2 @ * 3 \$ 1 # 7 8 4 % 5 £ 9
Letter codes:	G J B P O A K N F Q L S D M H

Conditions:

- If the 1st element in the group is a symbol and the last one is an odd digit, the code for both will be X.
- If the 1st element is an even digit and the last element is a symbol, then codes for each of them gets interchanged.
- If the 1st element is an odd digit and the last element is an even digit then the code for both will be Y.
- If both the 1st and the last elements are symbols, then the code for both will be Z.

What will be the code for the following groups of numbers and symbols?

33. 7 4 5 9 8 3 6

- (1) FLDHQOG (2) GLDHQOF
 (3) FLDQHOG (4) YLDHQOY

34. # 6 3 4 1 8 5

- (1) NGLOKQD
- (2) DGOLKQN
- (3) XGOLKQX
- (4) ZGOLKQZ

Directions for questions 35 and 36: Given below are the codes for the digits/symbols. Answer the questions based on the codes and the conditions given below the code.

Digit/ symbol:	3	8	£	4	\$	@	1	#	7	%	9	©	*	2	5	S	6
Letter code:	D	A	M	H	Q	C	R	G	B	J	F	K	N	L	T	P	E

Conditions:

- (1) If both the left most and the right most elements are symbols, then the codes for the first two elements get interchanged between them and the codes for the last two elements get interchanged between them.
- (2) If the left most element is a symbol and the right most is an even digit then the code for both will be y.
- (3) If the left most element is an odd digit and the right most element is a symbol, then the codes of these two get interchanged.
- (4) If the left most element is an odd digit and the right most element is an even digit then the code for both will be w.
- (5) If the left most element in the group is an even digit and the right most element is an odd digit then, reverse the order of the code for the group.

35. 8 3 6 @ 4 9 7

- (1) PDECHFA
- (2) BFHCEDA
- (3) ADECHFB
- (4) XDECHFX

36. \$ 4 7 8 3 © 6

- (1) EKDABHQ
- (2) ZHBADKZ
- (3) EHBADKQ
- (4) YHBADKY

Directions for questions 37 to 40: Select the correct alternative from the given choices.

37. In a certain code language, if Violet is called as Green, Green is called as Red, Red is called as Brown, Brown is called as Orange, Orange is called as Yellow, Yellow is called as Blue and Blue is called as Indigo, then what is the colour of human blood in that language?

- (1) Red
- (2) Blue
- (3) Green
- (4) Brown

38. In a certain code, language Bread is called Butter, Butter is called Milk, Milk is called Shirt, Shirt is called Shoe, Shoe is called Bicycle, Bicycle is called Watch, Watch is called Aeroplane and Aeroplane is called Ship, then which of the following indicates time in that language?

- (1) Watch
- (2) Bicycle
- (3) Milk
- (4) Aeroplane

39. In a certain code language, if each letter in the English alphabet, with an odd numbered value is given a code of 2 and each of the remaining letters is coded as 1, then what is the code for the word SALVATION?

- (1) 211221121
- (2) 211121212
- (3) 221112122
- (4) 221121221

40. In a certain code language, if the word MANAGEMENT is coded as DAEAGEDDEEB, then how is the word TREASURE coded in that language?

- (1) BIFAIDHE
- (2) BIEAJCIE
- (3) BJEADICE
- (4) BJFAIJCE

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 20: In each of the following questions, three out of the following five are alike and hence form a group. Find the one which does not belong to that group.

- 1. (1) 16
- (3) 36
- (2) 28
- (4) 64
- 2. (1) 41
- (3) 53
- (2) 43
- (4) 57

- 3. (1) 42624
- (3) 84284
- (2) 37573
- (4) 93339
- 4. (1) 4422
- (3) 4242
- (2) 2442
- (4) 2244
- 5. (1) 358
- (3) 134
- (2) 246
- (4) 862
- 6. (1) 123
- (3) 231
- (2) 132
- (4) 321

7. (1) ABB (2) BCC
(3) CCCDDDD (4) DDDDEEEEEE
8. (1) BDFL (2) PRUZ
(3) JLOT (4) CEHM
9. (1) YCAEC (2) KOMQO
(3) PTRUT (4) GKIMK
10. (1) 1P6 (2) 2Y4
(3) 2T0 (4) 1R8
11. (1) Cat (2) Dog
(3) Tiger (4) Elephant
12. (1) Tiruvanantapuram (2) Hyderabad
(3) Calicut (4) Bangalore
13. (1) Asteroid (2) Star
(3) Planet (4) Rocket
14. (1) Walk (2) Talk
(3) Drink (4) Plank
15. (1) Ganga (2) Hirakud
(3) Yamuna (4) Sutlez
16. (1) 30 (2) 27
(3) 36 (4) 45
17. (1) Sculpture (2) Blacksmith
(3) Carpenter (4) Architect
18. (1) Daughter-in-law (2) Mother
(3) Sister (4) Daughter
19. (1) Museum (2) Auction
(3) Exhibition (4) Botanical park
20. (1) Deal (2) Seal
(3) Zeal (4) Real

Directions for questions 21 to 24: Select the correct alternative from the given choices.

21. In a certain code language, if the word LIBERAL is coded as MJCFBSBM, then how is the word REDUCTION coded in that language?
(1) EDCTBSHNM (2) SFEVDUJPO
(3) SFEVCTJPO (4) SFDUCTJPO
22. In a certain code language, if the word CERTIFY is coded as BURGIVX, then how is the word ADJACENT coded in that language?
(1) ZWQZXVMG (2) GMVXZQWZ
(3) RMVWYJWH (4) GMXVWRVZ

23. In a certain code language, if the word ADVANTAGE is coded as EFWEPVEHI, then how is the word DUPLICATE coded in that language?

(1) EAQMODEUF (2) FAQMODEUI
(3) FAQMODEVI (4) FAQMJDEVI

24. In a certain code language, if FRAME = 48 and HURDLE = 74, then FIGMENT = ?

(1) 74 (2) 89
(3) 91 (4) 81

Directions for questions 25 and 26: These questions are based on the following data.

In a certain code language, if the word ROUTINE is coded as JMPRRLJ and the word FIDELITY is coded as LGHCXGNW, then how will you code the following words in that language?

25. BRANCH

(1) DTBPFJ (2) DPBPFFJ
(3) DPBLFF (4) DPBLHJ

26. MINUTE

(1) $M_1H_1N_1S_2J_2E_1$ (2) $M_1C_3G_2G_3E_4E_1$
(3) $M_1C_3G_2K_2D_5E_1$ (4) $M_1H_1G_2S_2D_5E_2$

Directions for question 27: For the following groups of letters given in Column I, the codes are given in Column II. Answer the following questions by finding the codes for the groups from the given columns.

Column I

(1) lit kit bit dit
(2) fit git mit kit
(3) rit bit git tit
(4) nit dit fit rit

Column II

b r p d
t d s v
x p v w
r s x j

27. What is the code for kit?

(1) r (2) p
(3) x (4) d

Directions for question 28: For the words given in column I, the codes are given in Column II. Answer the following questions by finding the codes for the letters from the words and their codes given in the columns.

Column I

(1) PRETEND
(2) COMMON
(3) HOUSE
(4) SUPPORT
(5) DRUM

Column II

4396408
615715
4*2&1
3*21839
5*08

28. What is the code for the word EMPEROR?

- (1) 5495717 (2) 4534818
(3) 3453919 (4) 4537178

Directions for questions 29 and 30: For the following sentences given in column I, the codes are given in column II. Answer the following questions by finding the codes for the words from the given columns.

Column I	Column II
All people are not poet	kak cac hah faf zaz
Great people are happy	tat dad faf zaz
Krishna is a god	nan gag rar mam
Tagore is a great poet	mam kak dad nan lal
God make people happy	tat gag faf sas
No person is happy	xax pap faf mam

29. What is the code for the word 'not' in that language?

- (1) cac
(2) hah
(3) tat
(4) Cannot be determined

30. If the code for "Mahima is not a person" is "nan xax mam yay cac", then what is the code for "Mahima make all people happy"?

- (1) xax yah cac tat sas
(2) faf yay sas cac tat
(3) hah yay faf tat sas
(4) tat xax yay tat sas

Directions for questions 31 and 32: For the following sentences given in column I, the codes are given in column II. Answer the following questions by finding the codes for the words from the given columns.

Column I	Column II
I do not cheat.	1 # 2 7
I win the gold medal	9 @ 7 6 Ψ
I am not the last	3 7 6 π #
Manav do not loose	1 8 # %
Last person win the silver medal	4 π 6 θ @ Ψ
Manav is a person	4 5 8 *

31. What is the code for 'gold'?

- (1) 9 (2) @
(3) 7 (4) Ψ

32. What can be the code for "I loose the gold medal"?

- (1) 7 9 @ % 6 (2) 6 8 9 ψ %
(3) 7 9 5 % 6 (4) ψ 6 9 7 @

Directions for questions 33 and 34: Given below are the codes for the digits/symbols. Study the conditions given below and answer the questions that follow.

Digit/ symbol:	6 2 @ * 3 \$ 1 # 7 8 4 % 5 £ 9
Letter codes:	G J B P O A K N F Q L S D M H

Conditions:

- (1) If the 1st element in the group is a symbol and the last one is an odd digit, the code for both will be X.
- (2) If the 1st element is an even digit and the last element is a symbol, then codes for each of them gets interchanged.
- (3) If the 1st element is an odd digit and the last element is an even digit then the code for both will be Y.
- (4) If both the 1st and the last elements are symbols, then the code for both will be Z.

What will be the code for the following groups of numbers and symbols?

33. 8 4 6 9 7 3 %

- (1) QLGHFOS (2) QLGHFOS
(3) XLGHFOX (4) QOFHGLS

34. 4 3 2 9 6 1 @

- (1) LOJHGKB (2) XOJHGKX
(3) YOJHGKY (4) BOJHGKL

Directions for questions 35 and 36: Given below are the codes for the digits/symbols. Answer the questions based on the codes and the conditions given below the code.

Digit/ symbol:	3 8 £ 4 \$ @ 1 # 7 % 9 © * 2 5 S 6
Letter codes:	D A M H Q C R G B J F K N L T P E

Conditions:

- (1) If both the left most and the right most elements are symbols, then the codes for the first two elements get interchanged between them and the codes for the last two elements get interchanged between them.
- (2) If the left most element is a symbol and the right most is an even digit then the code for both will be y.
- (3) If the left most element is an odd digit and the right most element is a symbol, then the codes of these two get interchanged.
- (4) If the left most element is an odd digit and the right most element is an even digit then the code for both will be w.

- (5) If the left most element in the group is an even digit and the right most element is an odd digit then, reverse the order of the code for the group.

35. 3 # % 7 9 6 4

- (1) HEFBJGD (2) WGJBF EW
(3) XGJBFE X (4) HGJBFED

36. 5 1 © 2 6 9 @

- (1) YRKLEFY (2) ZRKLEFZ
(3) XRKLEFX (4) CRKLEFT

Directions for questions 37 to 40: Select the correct alternative from the given choices.

37. In a certain code language, if Pen means Eraser, Eraser means Book, Book means Scale, Scale means Sharpener, Sharpener means Duster and Duster means Table, then what is the name of the object that is used to clean the black board in that language?

- (1) Duster (2) Sharpener
(3) Scale (4) Table

38. In a certain code language, the letters in the English alphabet are coded as follows, based on their place values. Each letter with a multiple of 2 as place value are given 1 as code, and the ones with a multiple of 3 as place value are given 2 as code, in case of a clash, 1 prevails and the rest of the letters are given 3 as code. Then what is the code for the word ALPHABET?

- (1) 31313113 (2) 31113131
(3) 13331313 (4) 31131131

39. In a certain code language, if each letter in the English alphabet, which has prime number place value is coded as 1 and each of the remaining letters are coded as 2, then what is the code for the word LANGUAGE?

- (1) 12211221 (2) 11212121
(3) 22212211 (4) 22212121

40. In a certain code language if RAIN is coded as abcd, GAIN is coded as bcde and PAIN is coded as bcd, then what is the code for the word GRAIN?

- (1) abcde (2) bcdef
(3) acdfe (4) abcfe

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

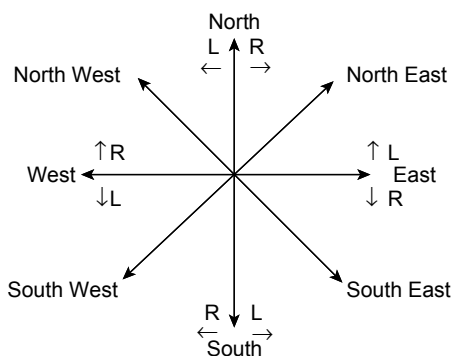
- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 2 | 4. 2 | 5. 3 | 6. 4 | 7. 2 | 8. 3 | 9. 2 | 10. 4 |
| 11. 1 | 12. 2 | 13. 3 | 14. 1 | 15. 4 | 16. 3 | 17. 4 | 18. 3 | 19. 3 | 20. 4 |
| 21. 2 | 22. 3 | 23. 1 | 24. 1 | 25. 4 | 26. 2 | 27. 3 | 28. 4 | 29. 3 | 30. 4 |
| 31. 4 | 32. 3 | 33. 4 | 34. 3 | 35. 2 | 36. 4 | 37. 4 | 38. 4 | 39. 4 | 40. 2 |

PRACTICE EXERCISE 2 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 3 | 4. 3 | 5. 4 | 6. 2 | 7. 2 | 8. 1 | 9. 3 | 10. 2 |
| 11. 4 | 12. 3 | 13. 4 | 14. 4 | 15. 2 | 16. 1 | 17. 4 | 18. 1 | 19. 2 | 20. 4 |
| 21. 2 | 22. 2 | 23. 3 | 24. 4 | 25. 3 | 26. 2 | 27. 4 | 28. 2 | 29. 4 | 30. 3 |
| 31. 1 | 32. 1 | 33. 1 | 34. 4 | 35. 2 | 36. 4 | 37. 2 | 38. 2 | 39. 3 | 40. 1 |

Direction Sense, Symbols and Notations and Blood Relations

The questions on direction sense typically involve a person moving certain distances in specified directions. Then, the student is asked to find out the distance between the initial and the final points. The easiest way of solving these



problems is to draw a diagram as you read the information given in the problem and ensure that the diagram reflects all the information given in the problem.

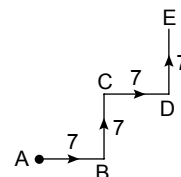
To solve these types of problems, the student should be aware of the directions. The student should also recognize the left and right of a person walking in a particular direction. The following diagram shows all the directions and left (L) and right (R) of a person walking in that direction and the student should memorise the diagram.

NOTE: The distance from a particular point after travelling a distance of x metres in the horizontal direction and a distance of y metres in the vertical direction is equal to $\sqrt{x^2 + y^2}$ (Please note that in common usage, North South direction is referred to as “vertical” direction and the East West direction is referred to as the “horizontal” direction).

Solved Examples

1. A person travels a distance of 7 km towards east from his house, then travels 7 km towards north and then a distance of 7 km towards east and finally 7 km towards north. What is the vertical distance travelled by him?

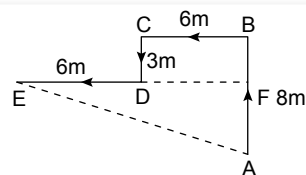
Solution: Let A and E be the initial and the final positions. The vertical distance travelled = $BC + ED = (7 + 7) \text{ km} = 14 \text{ km}$.



2. Starting from his house, Sachin walks a distance of 8 m towards north, then he turns left and walks 6 m, then walks 3 m towards south and finally travels 6 m towards west. to reach his office. What is the distance between his house and office and also find in which direction is his office situated with respect to his house?

Solution: Let A be the Sachin's house and E his office.

The distance between A and E



$$\begin{aligned}
 &= \sqrt{(EF)^2 + (AF)^2} = \sqrt{(ED + CB)^2 + (AB - FB)^2} \\
 &= \sqrt{(ED + CB)^2 + (AB - CD)^2} = \sqrt{12^2 + 5^2} \\
 &= 13 \text{ m.}
 \end{aligned}$$

His office is towards northwest of his house.

The basic approach for the questions of this chapter is more or less similar to that of coding and decoding. As in the questions of coding and decoding, a basic word is coded in a particular way and the candidate is asked to code another word using the same logic.

Similarly, in "Symbols and Notations", one has to study the symbols and their meanings carefully which are given against them. Then, the meanings given are to be used in place of those symbols in answering the questions. The word "Notation" basically stands for the meaning which each symbol will be assigned.

The questions can be based on Blood Relations or Mathematical Operations (or Operator based questions).

This chapter deals with Mathematical Operations.

MATHEMATICAL OPERATIONS

Symbols for these types of questions stand for mathematical operations i.e., +, -, ×, ÷, >, <, ≥, ≤, = and ≠. So one must replace the symbols by mathematical operations and apply the 'BODMAS' rule to find the value of the given expression. Symbols like Δ, ∇, *, @, \$ etc., are used by giving a proper definition of the symbol used. An example belonging to this category is also explained below.

Solved Examples

1. If '-' stands for '×', '×' stands for '+', '+' stands for '÷' and '÷' stands for '-', then what is the value of $9 \div 18 \times 15 + 3 - 6 \times 12$?

- (1) 24 (2) 30
(3) 33 (4) 42

Solution: The given expression is $9 \div 18 \times 15 + 3 - 6 \times 12$. By converting the symbols according to the given definitions, we get $9 - 18 + 15 \div 3 \times 6 + 12$. Solving this by BODMAS rule, we get the value as 33.

Choice (3)

2. If $a \$ b = a^2b^2 - ab$, then $3 \$ 8 =$

- (1) 600 (2) 552
(3) 576 (4) 625

Solution: Given $a \$ b = a^2b^2 - ab$.
 $\Rightarrow 3 \$ 8 = 3^2 \times 8^2 - 3 \times 8$

$$\begin{aligned}
 &= 9 \times 64 - 24 \\
 &= 576 - 24 = 552.
 \end{aligned}$$

Choice (2)

3. If 'Δ' means 'is less than', '\$' means 'is greater than' and '£' means 'is equal to' and given that $a \Delta b$, $c \text{ £ } d$ and $c \$ b$, then which of the following is true?

- (1) $d \Delta a$ (2) $b \$ d$
(3) $a \text{ £ } c$ (4) $a \Delta b \Delta c$

Solution: $a \Delta b \Rightarrow a < b$

$$c \$ b \Rightarrow c > b \Rightarrow b < c$$

$$c \text{ £ } d \Rightarrow c = d \quad \therefore a < b < c = d$$

$$(1) d \Delta a \Rightarrow d < a \rightarrow \text{false}$$

$$(2) b \$ d \Rightarrow b > d \rightarrow \text{false}$$

$$(3) a \text{ £ } c \Rightarrow a = c \rightarrow \text{false}$$

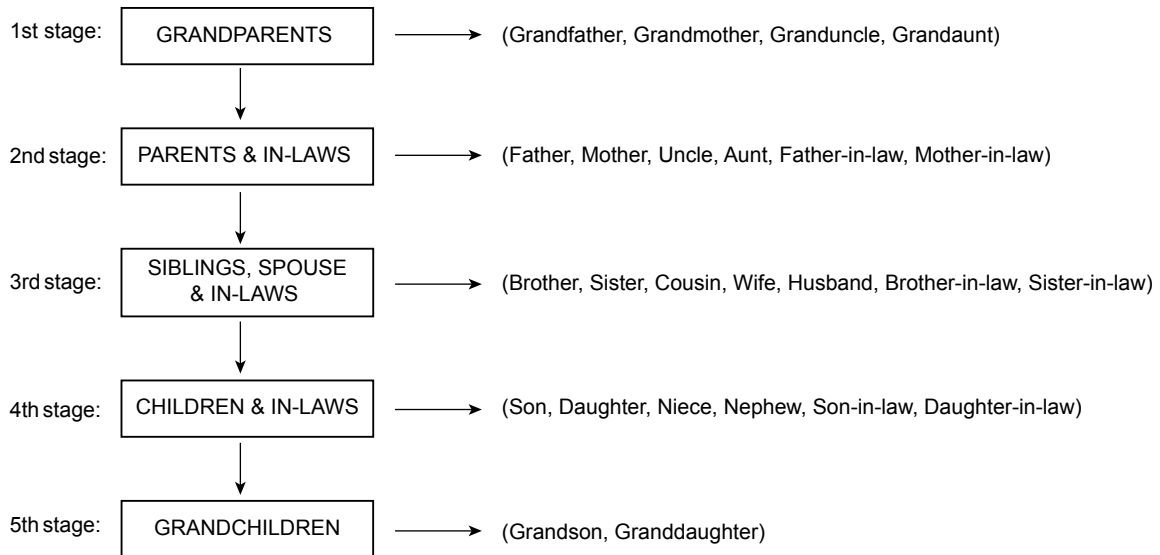
$$(4) a \Delta b \Delta c \Rightarrow a < b < c \rightarrow \text{true}$$

Choice (4)

There are two types of questions based on blood relations that are given in different competitive examinations. For the sake of convenience we will refer to the two types of questions as Type I and Type II. (Please note that the questions on blood relationships are not categorized as above in the actual exam papers. It is being done purely from the point of better understanding).

In the exams, the success of a candidate in the questions on blood relations depends upon his knowledge about various blood relations. Some of the relationships given below help in solving the problems.

The easiest and non-confusing way to solve these types of problems would be to draw a family tree diagram and increase the levels in the hierarchy as shown below:



Mother's or Father's son	: Brother
Mother's or Father's daughter	: Sister
Mother's or Father's brother	: Uncle
Mother's or Father's sister	: Aunt
Mother's or Father's mother	: Grandmother
Mother's or Father's father	: Grandfather
Grandmother's brother	: Granduncle
Grandmother's sister	: Grandaunt
Grandfather's brother	: Granduncle
Grandfather's sister	: Grandaunt
Sister's or Brother's son	: Nephew
Sister's or Brother's daughter	: Niece
Uncle or Aunt's son or daughter	: Cousin
Son's wife	: Daughter-in-law
Daughter's husband	: Son-in-law
Husband's or Wife's sister	: Sister-in-law
Husband's or Wife's brother	: Brother-in-law
Sister's husband	: Brother-in-law
Brother's wife	: Sister-in-law
Children of same parents	: Siblings (could be all brothers, all sisters or some brothers and some sisters)

Children	: Son, Daughter
Children's Children	: Grandchildren (Grandson, Granddaughter)

In addition, remember the word spouse which means either husband or wife.

Grandfather and grandmother will come in the first stage; mother, father, uncle and aunt will come in the second stage; sister, brother and cousin will come at the third stage; son, daughter, niece and nephew will come in the fourth stage and finally, granddaughters and grandsons will come. The above stages are made from the point of view of an individual.

In Type—I questions, the relationship between two people is given through a roundabout way of relating them through other people. We have to go through the series of relationships and finally determine the relationship between the two people given in the question. The relationship can be given as a simple statement or as a statement made by a person. In the first example given below, a person is involved in making a statement whereas in the second question, there is no person involved in making a statement.

Solved Examples

1. A's father's mother-in-law's only daughter's son is B. How is A related to B?

- (1) Brother
- (2) Sister
- (3) Nephew
- (4) Cannot be determined

☞ **Solution:** A's father's mother-in-law's only daughter is A's mother. A's mother's son is A's brother.

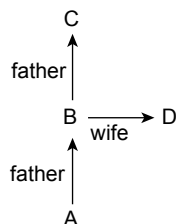
But A can be either brother or sister to B.

Choice (4)

2. If A's father is B, C is the father of B and D is A's mother, then How is C related to D?

- (1) Father
- (2) Grandfather
- (3) Father-in-law
- (4) Uncle

☞ **Solution:** A's father is B and mother is D. Therefore D is B's wife and C is the father of B. Hence C is D's father-in-law.



Choice (3)

3. $A + B$ means A is the son of B.

$A - B$ means A is the daughter of B.

$A \times B$ means A is the father of B.

$A \div B$ means A is the mother of B.

If $M \times N + O - P \div Q$, then how is M related to Q?

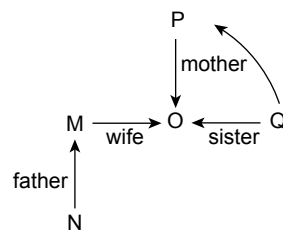
- (1) Husband
- (2) Cousin
- (3) Brother-in-law
- (4) Uncle

☞ **Solution:** $M \times N + O - P \div Q$ means M is the father of N, N is the son of O, O is the daughter of P, P is the mother of Q.

M is the father of N and N is the son of O means M is the husband of O.

O is the daughter of P and P is the mother of Q means O is the sister of Q.

M is the husband of O and O is the sister of Q means M is the brother-in-law of Q.



Choice (3)

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 9: Select the correct alternative from the given choices.

- From her house, Shriya travels 8 km towards south. She then turns right and travels 12 km. She again travels 8 km to her left. How far is she from the house (in km)?
 (1) 25 (2) 20
 (3) >30 (4) ≥ 40
- My dog Bunty, runs 30 m towards west, turns left and runs 10 m, then turns right, and runs 5 m, then turns left and runs 2 m and again turns right, runs 12 m. Finally, it turns left and runs 7 m. In which direction is it running now?
 (1) East (2) West
 (3) North (4) South
- Sachin travels 16 km towards west and from there, he travels 8 km towards the east. Now, he goes 4 km towards the north. In which direction is he with respect to the starting point?
 (1) North-west (2) West
 (3) South-east (4) North
- Mr Deshmukh starts from his school, travels a distance of 2 km southwards, and then travels a distance of 4 km towards east, then a distance of 3 km to his right, and then he turned right and travelled 4 km and 2 km after the first and second turns respectively. Finally, he travelled 4 km towards east. How far is he from his school and in which direction?
 (1) 5 km and South-east (2) 5 km and North-west
 (3) 7 km and South (4) 7 km and South-east
- Mr Thakre travels 12 km towards east, then 8 km towards north and finally 6 km towards west. How far is he from the starting point and in which direction?
 (1) 10 km and North-east
 (2) 10 km and North-west
 (3) 18 km and North-west
 (4) 24 km and North-east
- Sohil travels 18 km southwards, and then travels 4 km to his left. Again, he travels 4 km southwards. He travels another 11 km to his right. Now he turns to his right and travels 5 km. What is his position from the starting point?

- 22 km south, 15 km west
- 19 km south, 15 km west
- 17 km south, 7 km west
- 23 km south, 15 km west

- A clock is placed in such a way, that at 12 O'clock, the hands point towards north-east. In which direction does the hour hand point at 6 pm?
 (1) South-west (2) South-east
 (3) East (4) South
- One evening, Dinesh and Swetha sat in a park such that their backs are towards each other. If Dinesh's shadow is falling to his left then which direction is Swetha facing?
 (1) North-east (2) North
 (3) East (4) South
- One evening Avinash and Abhinav are talking to each other while sitting at either ends of See-Saw facing each other. Avinash observed that his shadow is falling to his left. Which direction is Abhinav facing?
 (1) North (2) East
 (3) West (4) South

Directions for question 10: In a certain code language, '+' means '×', '×' means '−', '−' means '÷' and '÷' means '+'. Simplify the following expressions using the above directions, in which the mathematical operators are written according to the code language.

- $16 - 2 + 4 \div 16 - 8 \times 2$
 (1) −15 (2) 2
 (3) 4 (4) 32

Directions for questions 11 and 12: These questions are based on the following information.

- a + b means a is neither less than nor equal to b.
- a − b means a is neither smaller nor greater than b.
- a = b means a is not less than b.
- a × b means a is not greater than b.
- a ÷ b means a is neither greater than nor equal to b.

Each of the following questions consists of a statement followed by two conclusions.

Give your answer as

- if only conclusion (I) follows.
- if only conclusion (II) follows.

- (3) if both conclusions (I) and (II) follow.
 (4) if neither (I) nor (II) follows.

11. Statement:

$$A + B, B \times C, C \times D$$

Conclusions:

- I. $A + D$
 II. $A = C$

12. Statement:

$$X + Y, Y \times Z, W = Z$$

Conclusions:

- I. $Y \times W$
 II. $X + Z$

Directions for questions 13 and 14: These questions are based on the following information.

- $a \leq b$ means a is less than or equal to b .
 $a \geq b$ means a is greater than or equal to b .
 $a \uparrow b$ means a is less than b .
 $a \bullet b$ means a is greater than b .
 $a \blacktriangle b$ means a is equal to b .

Each of the following questions consists of a statement followed by two conclusions.

Give your answer as

- (1) if only conclusion (I) follows
 (2) if only conclusion (II) follows
 (3) if both conclusions (I) and (II) follow
 (4) if neither (I) nor (II) follows

13. Statement:

$$w \bullet x, x \leq y, y \uparrow z$$

Conclusions:

- I. $w \blacktriangle y$
 II. $w \uparrow z$

14. Statement:

$$m \blacktriangle n, n \leq o, o \bullet p$$

Conclusions:

- I. $p \bullet m$
 II. $m \leq o$

Directions for questions 15 and 16: These questions are based on the following information.

- $p \nabla q$ means p is neither less than nor equal to q .
 $p @ q$ means p is neither greater than nor equal to q .
 $p \# q$ means p is not less than q .

$p \Delta q$ means p is not greater than q .

$p \square q$ means p is neither smaller nor greater than q .

Each of the following question consists of a statement followed by two conclusions.

Give your answer as

- (1) if only conclusion (I) follows
 (2) if only conclusion (II) follows
 (3) if both conclusions (I) and (II) follow
 (4) if neither (I) nor (II) follows

15. Statement:

$$p \# q, q \nabla r, r \Delta s$$

Conclusions:

- I. $s \nabla p$
 II. $q @ s$

16. Statement:

$$s \nabla r, q \# p, r \Delta p$$

Conclusions:

- I. $q \# r$
 II. $s \nabla q$

Directions for questions 17 and 18: These questions are based on following information.

In the following questions, the symbols

@, #, \$, %, ©, and % are used with the following meanings.

$P @ Q$ means P is neither greater than nor equal to Q .

$P \# Q$ means P is not lesser than Q .

$P \$ Q$ means P is neither greater than nor lesser than Q .

$P \odot Q$ means P is not greater than Q .

$P \% Q$ means P is neither lesser than nor equal to Q .

In each of the following questions, four statements followed by three conclusions marked I, II and III are given. Assuming the statements to true, find which of the three conclusions follow(s) the given statements.

17. Statements:

$$J \% M, J \odot R, S \$ R, S \odot T.$$

Conclusions:

- I. $J @ S$
 II. $T \% J$
 III. $J \$ T$

- (1) Only I follows.
 (2) Only II follows.
 (3) Only III follows.
 (4) Either II or III follows

18. Statements:

F @G, G # J, H@J, H \$ I.

Conclusions:

- I. F % J
- II. I @ G
- III. J % I
- (1) Only I and II follows.
- (2) Only I and III follow.
- (3) Only II and III follow.
- (4) All follow.

Directions for questions 19 and 20: In the following questions, symbols \$, ©, @, * and # are used with the following meanings illustrated.

A\$B means A is neither greater than nor equal to B.

A©B means A is neither lesser than nor equal to B.

A@B means A is not greater than B.

A*B means A is not lesser than B.

A#B means A is neither greater than nor lesser than B.

In each of the following questions assuming the given four statements to be true, find out which of the four conclusions marked I, II, III, and IV given below is/are definitely follows(s) the given statements.

19. Statements:

C*D, D@F, F©G, G\$H

Conclusions:

- I. C © F
- II. H © F
- III. G\$D
- IV. D \$H
- (1) Only I follows
- (2) Only II follows
- (3) Only III follows
- (4) None follows

20. Statements:

G\$I, I*K, K#M, M\$O

Conclusions:

- I. I * M
- II. K\$O
- III. G©K
- IV. I@M
- (1) Only I and II follow.
- (2) Only II and III follow.
- (3) Only III and IV follow.
- (4) Only I, II and III follow.

Directions for questions 21 and 22: Select the correct alternative from given choices.

21. Which of the following symbol should replace question mark (?) in the given expression in order to make the statements 'F > C' and 'B < E' definitely follow?

F < K ≥ B ? C ≤ D > E

- (1) ≥
- (2) ≤
- (3) =
- (4) such a case is not possible.

22. In which of the following expressions will the expression R ≤ P does not hold true?

- (1) M < P = S ≥ G ≥ R ≤ T
- (2) M > P = S ≥ G = R ≤ T
- (3) M = P < S ≤ G ≤ R = T
- (4) M > P ≥ S ≥ G = R ≥ T

Directions for question 23: Study the following sequence carefully and answer the questions given below it.

M 4 C @ F 7 1 \$ A E N 9 H > 5 ↓ K © 3 ? B J ≠ G 8 D 6 I L 2

23. How many such symbols are there in the above sequence of elements which are immediately preceded by an alphabet and immediately following by a digit?

- (1) Zero
- (2) One
- (3) Two
- (4) Three

Directions for question 24: Study the following sequence carefully and answer the questions given below it.

R K 5 9 # B 2 % * E ? A 8 L \$ I 4 S V 7 ! C 6 N @ H 1 3 & D

24. How many consonants are there, which are immediately followed by a digit but not immediately preceded by a consonant?

- (1) 3
- (2) 2
- (3) 1
- (4) 0

Directions for question 25: Study the following sequence carefully and answer the questions given below it.

2 T # K 7 P N 3 R ? 5 Q 1 S A 9 @ 4 E G % 8 J B 6 M ! V 9 Z

25. How many digits are there which are immediately followed by a symbol but not immediately preceded by a consonant?

- (1) 3
- (2) 1
- (3) 2
- (4) 4

Directions for question 26: In a certain instruction system, the different computation processes are written as follows.

- (a) 'A % B ! C' means 'A is added to the product of B and C'.

- (b) ' $A \odot B * C$ ' means 'the product of B and C is subtracted from A.'
- (c) ' $A \# B @ C$ ' means 'the product of A and B is divided by C.'
- (d) ' $A \bullet B \$ C$ ' means 'C is multiplied by the sum of A and B'.

You have to find out what will come in the place of question mark (?) in each question following the computation processes.

26. $100 \odot 20 * 3 = a$

$a \% 40 ! 5 = ?$

- (1) 140 (2) 240
(3) 340 (4) 360

Directions for question 27: In a certain instruction system, the different computation processes are written as follows.

- (a) ' $P \times Q + R$ ' means 'the product of Q and R is added to P'.
- (b) ' $P < Q > R$ ' means 'the sum of P and Q is divided by one-fourth of R'.
- (c) ' $P \pounds Q \$ R$ ' means 'R is subtracted from the product of P and Q'.
- (d) ' $P \Delta Q \square R$ ' means 'R is multiplied by the difference of P and Q'.

You have to find out what will come in the place of the question mark (?) in each question following the computation processes.

27. $10 \Delta 8 \square 4 = n$

$n \pounds 6 \$ 38 = ?$

- (1) 10 (2) 80
(3) 20 (4) 22

Directions for questions 28 to 35: Select the correct alternative from the given choices.

28. If it is possible to make a meaningful word using the sixth, seventh, ninth and tenth letters only once of the word "FUNDAMENTAL", what will be the first letter of the word? If no word can be formed, mark the answer as X. If two words can be formed, mark the answer as Y. If more than two words can be formed, mark the answer as Z.

- (1) T (2) M
(3) X (4) Z

29. Y is the daughter of X's brother's wife's father-in-law. Y is X's ____.

- (1) Niece (2) Daughter
(3) Sister (4) Sister-in-law

30. How is my father's mother's only daughter-in law's sister related to me?

- (1) Aunt (2) Sister
(3) Cousin (4) Niece

31. How is Ramu's mother-in-law's only daughter's son related to Ramu?

- (1) Nephew (2) Brother
(3) Son (4) Uncle

32. How is David's father's only daughter-in-law's son's wife related to David?

- (1) Daughter
(2) Daughter-in-law
(3) Niece
(4) Granddaughter

33. Tinku, introducing a person to Rinku, said "He is the father of your sister's son and he is also my mother's husband". How is Tinku's father related to Rinku's mother?

- (1) Nephew (2) Uncle
(3) Son-in-law (4) Father

34. My father's only brother's wife's only daughter's paternal uncle is my mother's

- (1) Father-in-law (2) Husband
(3) Son (4) Uncle

35. My mother's brother's son's mother is related to my maternal aunt as

- (1) Sister-in-law (2) Cousin
(3) Aunt (4) Mother-in-law

Directions for questions 36 and 37: Use the relations defined below and answer the following questions.

$A + B$ means A is the mother of B.

$A - B$ means A is the sister of B.

$A \times B$ means A is the father of B.

$A \div B$ means A is the son of B.

$A = B$ means A is the brother of B.

$A \neq B$ means A is the daughter of B.

36. Which of the following means, S is the son of T's daughter?

- (1) $T \times M + S + N$ (2) $T \times M + S = N$
(3) $T + M \times S - N$ (4) $S \div M \div T - N$

37. Which of the following means C is the grandfather of both D and E?

- (1) $C \times A \div D - E$ (2) $C + A + D \neq E$
(3) $C \div A \neq D = E$ (4) $C \times A \times D - E$

Directions for questions 38 and 39: Use the relationships given below and answer the questions followed.

$P \uparrow Q$ means P is the husband of Q

$P \$ Q$ means P is the father of Q.

$P \pounds Q$ means P is the mother of Q.

$P @ Q$ means P is the brother of Q.

$P \odot Q$ means P is the sister of Q.

$P \Delta Q$ means P is the son of Q.

$P \Rightarrow Q$ means P is the daughter of Q.

$P \downarrow Q$ means P is the wife of Q.

38. If $A \Delta B \pounds C \$ D$, then A is the ____ of D.

- (1) father (2) uncle
(3) brother (4) son

39. If $P \odot Q \Delta R @ S$ and $T \downarrow S$, then which among the following is a true statement?

- (1) S is the aunt of P.
(2) Q is the niece of S.
(3) S is the father of P and Q.
(4) P is the niece of S.

Directions for questions 40 (a) to (e): These questions are based on the information given below.

In a family of three generations, there are eight members, M and N are brothers. R is the grandson of Q. T is the

only niece of M, P is the sister-in-law of N. O is the mother-in-law of S. There are three married couples in the family. T is the daughter of S.

40. (a) How is R related to T?

- (1) Cousin
(2) Uncle
(3) Brother
(4) Cannot be determined

(b) How is Q related to S?

- (1) Grandfather (2) Uncle
(3) Father-in-law (4) Father

(c) How is P related to O?

- (1) Aunt (2) Mother
(3) Daughter-in-law (4) Mother-in-law

(d) How is O related to R?

- (1) Uncle (2) Grandmother
(3) Aunt (4) Grandfather

(e) In the family, the ratio of number of male members to that of female members

- (1) 3 : 5 (2) 5 : 3
(3) 1 : 1 (4) 2 : 3

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 9: Select the correct alternative from the given choices.

1. Two friends P and Q started walking towards each starting from points A and B respectively, which are 200 km apart. On a straight road P travelled for 30 km on road and stopped. Q travelled for 70 km, and took a left turn and travelled 20 km. Then he took a right turn and travelled 45 km and then turned to the main road and reached it. What is the distance, in km, between the friends now?

- (1) 45 (2) 55
(3) 65 (4) 75

2. Mr Bachchan started from his house and walked for 20 m towards east, where his friend Kiran joined him. They together walked for 10 m in the same direction. Then Mr Bachchan turned left while Kiran turned right and travelled 2 m and 8 m respectively. Kiran turned left to travel 4 m followed by 5 m to his right to reach his office. Mr Bachchan turned right and

travelled 12 m to reach his office. What is the shortest distance between the two offices?

- (1) 17 m (2) 18 m
(3) 20 m (4) 16 m

3. Mr Powar travels 10 km towards west and turns right to travel 4 km. Now he turns right and travels 7 km. In which direction is he now with respect to the starting position?

- (1) South-east (2) South-west
(3) North-east (4) North-west

4. Mr Gaykwad walks 20 km towards north. Then he turns right and walks further 21 km. How far is he from the starting point and in which direction?

- (1) 29 km and North-east
(2) $29\sqrt{2}$ km and South-west
(3) 10 km and North-east
(4) 20 km and North-west

5. Mr Tendulkar travels a distance of 10 km towards north, 7 km towards east and finally 14 km towards his left. How far is the initial position from the final position and in which direction?
- (1) 25 km and North-east
 - (2) 24 km and North-east
 - (3) 25 km and South-west
 - (4) 31 km and South-east
6. A clock is so placed that at 9 am the minute hand points towards north-east. Which direction does the hour hand point at 3 pm?
- (1) North-west
 - (2) South
 - (3) North-east
 - (4) South-east
7. A compass was damaged and its needle turned in such a manner that the pointer, which was showing east, is now showing south. One person went towards west as per above compass. In which direction did he actually go?
- (1) North
 - (2) South
 - (3) East
 - (4) West
8. One morning, Ram and Shyam were talking, facing each other. It is observed that Ram's shadow fell to his left. Then which direction was Shyam facing?
- (1) East
 - (2) South
 - (3) North-east
 - (4) North
9. One evening Prajay and Pranav are sitting in a park. Prajay's shadow is falling on Pranav, then which direction is Prajay facing?
- (1) South
 - (2) East
 - (3) West
 - (4) Cannot be determined

Directions for question 10: In a certain code language, '+' means '×', '×' means '-', '-' means '÷' and '÷' means '+'. Simplify the following expressions using the above directions, in which the mathematical operators are written according to the code language.

10. $2 \div 4 + 8 - 16 \times 32 \div 64 \times 128 \div 256$
- (1) $4 \cdot 5$
 - (2) 164
 - (3) 4
 - (4) 163

Directions for questions 11 and 12: These questions are based on the following information.

$a + b$ means a is neither less than nor equal to b.
 $a - b$ means a is neither smaller nor greater than b.
 $a = b$ means a is not less than b.

$a \times b$ means a is not greater than b.
 $a \div b$ means a is neither greater than nor equal to b.

Each of the following questions consists of a statement followed by two conclusions.

Give your answer as

- (1) if only conclusion (I) follows
- (2) if only conclusion (II) follows
- (3) if both conclusions (I) and (II) follow
- (4) if neither (I) nor (II) follows

11. Statement:

$$P \div Q, Q - R, R + S$$

Conclusions:

- I. $P = S$
- II. $P \div R$

12. Statement:

$$E \div F, F + G, G - H$$

Conclusions:

- I. $E + H$
- II. $F + H$

Directions for questions 13 and 14: These questions are based on the following information.

$a \leq b$ means a is less than or equal to b.
 $a \geq b$ means a is greater than or equal to b.
 $a \uparrow b$ means a is less than b.
 $a \bullet b$ means a is greater than b.
 $a \blacktriangle b$ means a is equal to b.

Each of the following questions consists of a statement followed by two conclusions.

Give your answer as

- (1) if only conclusion (I) follows
- (2) if only conclusion (II) follows
- (3) if either conclusion (I) or (II) follows
- (4) if neither (I) nor (II) follows

13. Statement:

$$a \bullet b, b \blacktriangle c, c \leq d$$

Conclusions:

- I. $d \uparrow b$
- II. $b \blacktriangle d$

14. Statement:

$$a \leq b, b \bullet c, c \uparrow d$$

Conclusions:

- I. $a \blacktriangle c$
- II. $b \leq d$

Directions for questions 15 and 16: These questions are based on the following information.

$p \star q$ means p is neither less than nor equal to q .
 $p @ q$ means p is neither greater than nor equal to q .
 $p \# q$ means p is not less than q .
 $p \Delta q$ means p is not greater than q .
 $p \square q$ means p is neither smaller nor greater than q .

Each of the following questions consists of a statement followed by two conclusions.

Give your answer as

- (1) if only conclusion (I) follows
- (2) if only conclusion (II) follows
- (3) if both conclusions (I) and (II) follow
- (4) if neither (I) nor (II) follows

15. Statement:

$k \square l, l \Delta m, m @ n$

Conclusions:

- I. $l @ n$
- II. $m \# k$

16. Statement:

$a \square b, c \Delta d, b \star c$

Conclusions:

- I. $a \star c$
- II. $b \# d$

Directions for questions 17 and 18: These questions are based on following information.

In the following questions, the symbols

@, #, \$, ©, and % are used with the following meanings.

$P @ Q$ means P is neither greater than nor equal to Q .
 $P \# Q$ means P is not lesser than Q .
 $P \$ Q$ means P is neither greater than nor lesser than Q .
 $P © Q$ means P is not greater than Q .
 $P \% Q$ means P is neither lesser than nor equal to Q .

In each of the following questions, four statements followed by three conclusions marked I, II and III are given. Assuming the statements to true, find which of the three conclusions follow(s) the given statements.

17. Statements:

$A \% B, B \# C, C @ D, D \% E$.

Conclusions:

- I. $A \% C$
- II. $D @ A$
- III. $B \# E$

- (1) Only I follows.
- (2) Only II follows.
- (3) Only III follows.
- (4) Either I or II follows

18. Statements:

$T \$ X, X \# W, W @ Y, Y \% Z$.

Conclusions:

- I. $T \% W$
- II. $X @ Y$
- III. $Z \% W$
- (1) Only I follows.
- (2) Only II and III follow.
- (3) Only I and III follow.
- (4) None follows

Directions for questions 19 and 20: In the following questions, symbols \$, ©, @, * and # are used with the following meanings illustrated.

$A \$ B$ means A is neither greater than nor equal to B .

$A © B$ means A is neither lesser than nor equal to B .

$A @ B$ means A is not greater than B .

$A * B$ means A is not lesser than B .

$A \# B$ means A is neither greater than nor lesser than B .

In each of the following questions assuming the given four statements to be true, find out which of the four conclusions marked I, II, III, and IV given below is/are definitely follows(s) the given statements.

19. Statements:

$M \$ K, K @ P, P \# Q, Q * R$

Conclusions:

- I. $M \$ P$
- II. $K \# Q$
- III. $K \$ Q$
- IV. $P © R$.
- (1) Only I follows
- (2) Only II and III follow.
- (3) Only III and IV follow.
- (4) Only I and either II or III follow.

20. Statements:

$P @ Q, Q \# R, R \$ S, S © T$

Conclusions:

- I. $P \$ T$
- II. $R \# P$
- III. $T \$ R$,
- IV. $R © P$
- (1) Only I and II follow.
- (2) Only II follows.

- (3) Either II or IV follows.
 (4) Only II and IV follow.

Directions for questions 21 and 22: Select the correct alternative from given choices.

21. Which of the following symbol should replace question mark (?) in the given expression in order to make the statements 'X > V' and 'Z < T' definitely follow?

$$T \geq X ? Y \geq Z > V \leq W.$$

- (1) > (2) ≥
 (3) < (4) ≤

22. In which of the following expressions will the expression $Q < M$ does not hold true?

- (1) $F \geq Q \leq R < S \leq T = M$
 (2) $F < Q > R \geq S > T = M$
 (3) $F \leq Q \leq R \leq S \leq T = M$
 (4) $F \leq Q \leq R \leq S \leq T < M$

Directions for question 23: Study the following sequence carefully and answer the questions given below it.

M 4 C @ F 7 1 \$ A E N 9 H > 5 ↓ K ⊙ 3 ? B J ≠ G 8 D 6 I L 2

23. Which of the following is the tenth element to the right of the fifteenth element from the right?

- (1) I (2) 6
 (3) D (4) 8

Directions for question 24: Study the following sequence carefully and answer the questions given below it.

R K 5 9 # B 2 % * E ? A 8 L \$ I 4 S V 7 ! C 6 N @ H 1 3 & D

24. Find the next term in the following series.

5#2, *?8, \$4V, _____

- (1) LIS (2) !6@
 (3) I4S (4) 13\$

Directions for question 25: Study the following sequence carefully and answer the questions given below it.

2 T # K 7 P N 3 R ? 5 Q 1 S A 9 @ 4 E G % 8 J B 6 M ! V 9 Z

25. Which is the 4th element to the right of the 23rd element from the right end?

- (1) Q (2) K
 (3) B (4) #

Directions for question 26: In a certain instruction system, the different computation processes are written as follows.

- (a) 'A % B ! C' means 'A is added to the product of B and C'.
 (b) 'A ⊙ B * C' means 'the product of B and C is subtracted from A'.

- (c) 'A # B @ C' means 'the product of A and B is divided by C'.

- (d) 'A • B \$ C' means 'C is multiplied by the sum of A and B'.

You have to find out what will come in the place of question mark (?) in each question following the computation processes.

26. $16 \bullet 14 \$ 4 = t$

$$t \# 10 @ 12 = ?$$

- (1) 700 (2) 300
 (3) 400 (4) 100

Directions for question 27: In a certain instruction system, the different computation processes are written as follows.

- (a) 'P × Q + R' means 'the product of Q and R is added to P'.

- (b) 'P < Q > R' means 'the sum of P and Q is divided by one-fourth of R'.

- (c) 'P £ Q \$ R' means 'R is subtracted from the product of P and Q'.

- (d) 'P Δ Q □ R' means 'R is multiplied by the difference of P and Q'.

You have to find out what will come in the place of the question mark (?) in each question following the computation processes.

27. $12 < 8 > 16 = b$

$$b \Delta 94 \square 4 = ?$$

- (1) 428 (2) 1006
 (3) 200 (4) 356

Directions for questions 28 to 35: Select the correct alternative from the given choices.

28. If it is possible to make a meaning word using the 2nd, 4th, 6th, and 8th letters only once of the word "CALENDAR" what will be the second letter of the word? If no word can be formed mark the answer as T. If two words can be formed, mark the answer as W. If more than two words can be formed, mark the answer as V.

- (1) E (2) V
 (3) W (4) A

29. Showing a photograph P said, "She is my mother's mother's son's daughter". How is the person in the photograph related to P?

- (1) Sister (2) Cousin
 (3) Niece (4) Mother

30. How is my grandmother's only child's husband's mother related to me?

- (1) Mother (2) Grandmother
(3) Aunt (4) Cousin

31. A is the father of B. C is the son of D. E is the brother of C while D is the sister of B. How is B related to E?

- (1) Uncle (2) Aunt
(3) Mother (4) Either (1) or (2)

32. Divya's father, pointing towards a person, said, "He is the brother of my father's only sibling". How is the person related to Divya?

- (1) Father (2) Uncle
(3) Brother (4) Grandfather

33. A is B's father, B is C's daughter, E is D's only sibling. C is D's only daughter. How is B related to E's niece?

- (1) Niece
(2) Granddaughter
(3) Daughter
(4) Mother

34. A's mother's son's only sister is B. How is A related to C, if B is the mother of C's daughter?

- (1) Brother (2) Brother-in-law
(3) Uncle (4) Nephew

35. Sanjana's brother-in-law is the son of Ramya. How is Sanjana's husband related to Ramya's husband if Sanjana had no siblings?

- (1) Nephew (2) Son
(3) Son-in-law (4) Father-in-law

Directions for questions 36 and 37: Use the relations defined below and answer the following questions.

$A + B$ means A is the mother of B.

$A - B$ means A is the sister of B.

$A \times B$ means A is the father of B.

$A \div B$ means A is the son of B.

$A = B$ means A is the brother of B.

$A \neq B$ means A is the daughter of B.

36. Which of the following means W is the uncle of Z?

- (1) $W \times A - B + Z$ (2) $W = A + B - Z$
(3) $W = A + B + Z$ (4) $W - A + B - Z$

37. Which of the following means I is the mother of L?

- (1) $I + B - C \neq D \times L$ (2) $I \neq B + C \times L$
(3) $I + B \times C \neq D - L$ (4) $I + B - C \times L$

Directions for questions 38 and 39: Use the relationships given below and answer the questions followed.

$P \uparrow Q$ means P is the husband of Q

$P \$ Q$ means P is the father of Q.

$P \notin Q$ means P is the mother of Q.

$P @ Q$ means P is the brother of Q.

$P \odot Q$ means P is the sister of Q.

$P \Delta Q$ means P is the son of Q.

$P \Rightarrow Q$ means P is the daughter of Q.

$P \downarrow Q$ means P is the wife of Q.

38. $E @ F \downarrow G \$ H$ means

- (1) H is the niece of E.
(2) H is the nephew of E.
(3) E is the paternal uncle of H.
(4) Either (1) or (2)

39. If $W \Rightarrow X \Delta Y \notin Z$, then which among the following is definitely true?

- (1) Z is the uncle of W.
(2) W is the niece of Z.
(3) W is the daughter of Z.
(4) W is the son of Z.

Directions for questions 40 (a) to (e): These questions are based on the information given below.

In a family of eight members, there are two married couples and a widow. A, the engineer, is married to a doctor. C, an architect is the wife of D, E, a student is the only child of C.

G is the son of H whose sister. F is the niece of the manager. B, a teacher, is the mother of only A and D.

40. (a) Who is the manager?

- (1) G (2) D
(3) H (4) A

(b) Who is the mother of F?

- (1) A
(2) B
(3) H
(4) Cannot be determined

(c) B is related to G as

- (1) Mother-in-law (2) Mother
(3) Grandmother (4) Daughter-in-law

(d) The profession of H is

- (1) Manager (2) Engineer
(3) Doctor (4) Teacher

(e) The profession of G is

- (1) Manager (2) Engineer
(3) Doctor (4) Data insufficient

ANSWER KEYS**PRACTICE EXERCISE 3 (A)**

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| 1. 2 | 2. 4 | 3. 1 | 4. 1 | 5. 1 | 6. 3 | 7. 1 | 8. 2 | 9. 1 | 10. 4 |
| 11. 4 | 12. 1 | 13. 4 | 14. 2 | 15. 4 | 16. 1 | 17. 4 | 18. 3 | 19. 4 | 20. 1 |
| 21. 4 | 22. 3 | 23. 3 | 24. 1 | 25. 2 | 26. 2 | 27. 1 | 28. 4 | 29. 3 | 30. 1 |
| 31. 3 | 32. 2 | 33. 3 | 34. 2 | 35. 1 | 36. 2 | 37. 4 | 38. 2 | 39. 4 | 40. (a) 4 |
| (b) 3 | (c) 3 | (d) 2 | (e) 3 | | | | | | |

PRACTICE EXERCISE 3 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------|
| 1. 2 | 2. 1 | 3. 4 | 4. 1 | 5. 3 | 6. 4 | 7. 1 | 8. 2 | 9. 4 | 10. 2 |
| 11. 2 | 12. 2 | 13. 3 | 14. 4 | 15. 3 | 16. 1 | 17. 1 | 18. 4 | 19. 4 | 20. 3 |
| 21. 1 | 22. 2 | 23. 3 | 24. 2 | 25. 1 | 26. 4 | 27. 4 | 28. 2 | 29. 2 | 30. 2 |
| 31. 4 | 32. 4 | 33. 3 | 34. 2 | 35. 2 | 36. 2 | 37. 1 | 38. 4 | 39. 2 | 40. (a) 2 |
| (b) 4 | (c) 3 | (d) 3 | (e) 4 | | | | | | |
-

Clocks and Calendars

The hour hand and the minute hand of a clock move in relation to each other continuously and at any given point of time, they make an angle between 0° and 180° with each other.

If the time shown by the clock is known, the angle between the hands can be calculated. Similarly, if the angle between two hands is known, the time shown by the clock can be found out.

When we say angle between the hands, we normally refer to the acute/obtuse angles (upto 180°) between the two hands and not the reflex angle ($> 180^\circ$).

For solving the problems on clocks, the following points will be helpful.

- Minute hand covers 360° in 1 hour, i.e., in 60 minutes. Hence, MINUTE HAND COVERS 6° PER MINUTE.
- Hour hand covers 360° in 12 hours. Hence, HOUR HAND COVERS 30° PER HOUR i.e., $1/2^\circ$ per minute.

The following additional points also should be remembered. In a period of 12 hours, the hands make an angle of

- 0° with each other (i.e., they coincide with each other), 11 times.
- 180° with each other (i.e., they lie on the same straight line), 11 times.
- any other angle with each other, 22 times.

Note: We can also solve the problems on clocks using the method of “Relative Velocity”

In 1 minute, Minute Hand covers 6° and Hour hand covers $1/2^\circ$.

Therefore, Relative Velocity = $6 - 1/2 = 5\frac{1}{2}^\circ$ per minute. Alternately, in 1 hour, the minute hand covers 60 minute divisions whereas the hour hand covers 5 minute divisions.

\therefore Relative Speed = $60 - 5 = 55$ minutes per hour.

However, adopting the approach of actual angles covered is by far the simplest and does not create any confusion.

Points to Note

- Any angle is made 22 times in a period of 12 hours.
- In a period of 12 hours, there are 11 coincidences of the two hands, when the two hands are in a straight line facing opposite directions.
- The time gap between any two coincidences is $12/11$ hours or $65\frac{5}{11}$ minutes.
- If the hands of a clock (which do not show the correct time) coincide every p minutes, then

If $p > 65\frac{5}{11}$, then the watch is going slow or losing time.
If $p < 65\frac{5}{11}$, then the watch is going fast or gaining time.

To calculate the angle ‘ θ ’ between the hands of a clock, we use the following formula (where m = minutes and h = hours)

$$(i) \theta = \frac{11}{2}m - 30h \left(\text{when } \frac{11}{2}m > 30h \right)$$

$$(ii) \theta = 30h - \frac{11}{2}m \left(\text{when } 30h > \frac{11}{2}m \right)$$

Solved Examples

1. What is the angle between the minute hand and the hour hand of a clock at 4 hours 30 minutes?

☞ **Solution:** We have $\theta = \frac{11}{2}m - 30h$

Where θ = angle

m = minutes

h = hours

Here, $m = 30$ and $h = 4$

$$\theta = \frac{11}{2} \times 30 - 30 \times 4$$

$$\Rightarrow \theta = 165 - 120$$

$$\Rightarrow \theta = 45^\circ$$

The angle between the two hands is 45° .

2. At what time between 4 and 5 O'clock will the minute hand and the hour hand make an angle of 30° with each other?

☞ **Solution:** $\theta = \frac{11}{2}m - 30h$,

here $\theta = 30^\circ$, $h = 4$, m

$$\Rightarrow 11m = 60h + 2\theta$$

$$\Rightarrow m = \frac{60h + 2\theta}{11} = \frac{60 \times 4 + 2 \times 30}{11}$$

$$= \frac{240 + 60}{11} = \frac{300}{11} = 27\frac{3}{11} \text{ min past 4.}$$

$$\theta = 30h - \frac{11}{2}m$$

$$11m = 60h - 2\theta \Rightarrow m = \frac{60h - 2\theta}{11}$$

$$\Rightarrow \frac{60 \times 4 - 2 \times 30}{11} = \frac{240 - 60}{11}$$

$$= \frac{180}{11} = 16\frac{4}{11} \text{ min past 4 O' clock}$$

Therefore, the angle between the two hands is 30°

when the time is 4 hours $16\frac{4}{11}$ min and 4 hours $27\frac{3}{11}$ min.

3. At what time between 4 and 5 O' clock will the minute hand and the hour hand coincide with each other?

☞ **Solution:** When the two hands coincide with each other the angle between them is 0° .

$$\theta = \frac{11}{2}m - 30h. \text{ Here } \theta = 0^\circ, h = 4 \quad \frac{11}{2}m = 30h$$

$$\Rightarrow 11m = 60h \Rightarrow m = \frac{60h}{11}$$

$$m = \frac{60 \times 4}{11} = \frac{240}{11} = 21\frac{9}{11} \text{ min past 4.}$$

The two hands of the clock coincide at 4 hours

$$21\frac{9}{11} \text{ min.}$$

Directions for questions 4 to 6: Select the correct alternative from the given choices.

4. At what time between 5 and 6 O'clock, will the hands of a clock be at an angle of 62° ?

(1) 5 hours $17\frac{2}{11}$ minutes

(2) 5 hours $38\frac{6}{11}$ minutes

(3) 5 hours 16 minutes

(4) Both (2) and (3)

☞ **Solution:** $\theta = 11/2 m - 30h$

$$11/2 m = \theta + 30h$$

$$11m = 2(62 + 30 \times 5)$$

$m = \frac{424}{11} = \text{At } 38\frac{6}{11} \text{ min past 5 O'clock the two hands of the clock are } 62^\circ \text{ apart.}$

$$\theta = 30h - 11/2 m \Rightarrow 11/2 m = 30h - \theta$$

$$\Rightarrow 11m = 2(30 \times 5 - 62) \Rightarrow m = 176/11 = \text{At 16 minutes past 5 O'clock, the two hands of the clock are } 62^\circ \text{ apart.}$$

Choice (4)

5. A clock is set to show the correct time at 10 a.m. The clock uniformly loses 12 min in a day. What will be the actual time when the clock shows 5 p.m. on the next day?

(1) 4:25 p.m.

(2) 4:45 p.m.

(3) 5:15 p.m.

(4) 4:50 p.m.

☞ **Solution:** Time from 10:00 a.m. a day to 5:00 p.m. the next day = 31 hours

23 hours 48 minutes of this clock = 24 hours of the correct clock.

$23\frac{4}{5} = \frac{119}{5}$ of this clock = 24 hours of the correct clock

$$31 \text{ hours of this clock} = \frac{31 \times 119}{24 \times 5} \\ = 31 \text{ hrs } 15 \text{ min (Approx.)}$$

The correct time is 31 hours 15 minutes after 10:00 a.m.

= 5 hours 15 minutes.

Choice (3)

6. The minute-hand of a clock overtakes the hour-hand at intervals of 62 minutes of a correct

time. How much in a day does the clock gain or lose?

- (1) $80^{80/341}$ minutes (2) $850^{80/311}$ minutes
(3) $80^{70/341}$ minutes (4) $80^{60/341}$ minutes

☞ **Solution:** In a correct clock, the hands of a clock coincide every $65\frac{5}{11}$ minutes. But in this case both the hands are together again after 62 minutes, hence the clock gains time.

Gain in 62 minutes = $(65\frac{5}{11} - 62) = 3\frac{5}{11}$ min gain.

Gain in 24 hours = $38/11 \times 60 \times 24 / 62$

$$= \frac{19 \times 60 \times 24}{11 \times 31} = 80\frac{80}{341}$$

So the clock gains $80^{80/341}$ minutes in 24 hours.

Choice (1)

Suppose, you are asked to find the day of the week on 30 June, 1974, it would be a tough job to find it if you do not know the method. The method of finding the day of the week lies in the number of “odd days”.

Note: Every 7th day will be the same day count wise, i.e., if today is Monday, then the 7th day counting from Tuesday onwards will once again be Monday. Hence, by dividing the total numbers of days by 7, the remainder obtained will be called the odd days.

Example:

$52 \text{ days} \div 7 = 3 \text{ odd days.}$

Leap and Ordinary Year

A non-leap year has 365 days whereas a leap year has one extra day because of 29 days in the month of February. Every year which is divisible by 4 is called a leap year. Leap year consists of 366 days, (52 complete weeks + 2 days), the extra two days are the odd days. So, a leap year has two odd days because $366 \div 7 = 2$ (remainder).

An ordinary year consists of 365 days (52 complete weeks + 1 day), the extra one day is the odd day. So, an ordinary year has one odd day.

Note: Every century, which is a multiple of 400, is a leap year.

Example:

400, 800, 1200, 1600 - - - are leap years.

Counting the number of Odd Days

100 years consist of 24 leap years + 76 ordinary years. (100 years when divided by 4, we get 25 leap years but 25th i.e., the 100th year is not a leap year, hence only 24 leap years)

$$= 2 \times 24 \text{ odd days} + 1 \times 76 \text{ odd days} \\ = 124 \text{ days} = 17 \text{ weeks} + 5 \text{ days}$$

The extra 5 days are the number of odd days.

So, 100 years contain 5 odd days.

Similarly, for 200 years we have 10 extra days (1 week + 3 days).

\therefore 200 years contains 3 odd days.

Similarly, 300 years contain 1 odd day and 400 years contain 0 odd days.

Counting of number of odd days, when only one date is given

Here, we take January 1st 1 AD as the earlier date and we assume that this day is a Monday. After this, the above mentioned method is applied to count the number of odd days and find the day of the week for the given date.

Counting number of odd days, when two dates are given

Any month which has 31 days, has 3 odd days.

($\because 31 \div 7$ leaves 3 as remainder) and any month having 30 days has 2 odd days ($30 \div 7$ leaves 2 as remainder).

Then, the total number of odd days are calculated by adding the odd days for each month. The final figure is again divided by 7 to get the final odd days.

Finally, the day of the week for the second date is obtained by adding the odd days to the day of the week for earlier date.

Solved Examples

1. If you were born on 28 January 1988, which was a Sunday, on what day of the week will your birthday fall in 1989?

- (1) Monday
(2) Tuesday
(3) Sunday
(4) Cannot be determined

☞ **Solution:** Since, 1988 is a leap year and as your birthday is before 29 February, your birthday in the next year will be two days after Sunday (since a leap year will have two odd days), which is Tuesday.

Choice (2)

2. If 8 March, 1988, which is your date of birth, is a Monday, on what day of the week will your birthday fall in the year 1989?

- (1) Tuesday (2) Sunday
(3) Monday (4) Friday

☞ **Solution:** Since, 8 March, 1988 comes after 29 February the number of odd days between 8 March 1988 and 8 March 1989 is only one. Hence, in 1989 your birthday will be one day after Monday, i.e., on Tuesday.

Choice (1)

3. If 25 May, 2003 is a Sunday, what day of the week will be 25 December in that year?

- (1) Monday (2) Tuesday
(3) Wednesday (4) Thursday

☞ **Solution:**

Month	Number of days
May	6
+	+
June	30
+	+
July	31
+	+

Month	Number of days
Aug	31
+	+
Sep	30
+	+
Oct	31
+	+
Nov	30
+	+
Dec	25

Total number of days = 214

Number of odd days in 214 days

$= 214 \div 7 = 30$ complete weeks + 4 odd days.

25 December will be 4 days after Sunday, i.e., on Thursday.

(or)

Month	Number of odd days
May	6
+	+
June	2
+	+
July	3
+	+
Aug	3
+	+
Sep	2
+	+
Oct	3
+	+
Nov	2
+	+
Dec	4

Total number of odd days = 25 and $25/7 = 4$ odd days i.e., 4 days after Sunday, i.e., Thursday.

Choice (4)

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. At what angle are the hands of a clock inclined at 50 minutes past 8?
 (1) 15° (2) $22\frac{1}{2}^\circ$
 (3) 35° (4) 45°
2. What is the angle between the two hands of a clock, when the clock shows 4.30 p.m.?
 (1) 15° (2) 30°
 (3) 45° (4) None of these
3. What is the angle between the two hands of a clock, when the time is 3.40 a.m.?
 (1) 60° (2) 90°
 (3) 110° (4) 130°
4. At what angle are the hands of a clock inclined at 30 minutes past 6?
 (1) $7\frac{1}{2}^\circ$ (2) $11\frac{1}{2}^\circ$
 (3) 15° (4) 23°
5. At what time between 9 O'clock and 10 O'clock are the hands of a clock in the opposite direction?
 (1) 9hrs. $17\frac{8}{11}$ min (2) 9hrs. $21\frac{9}{11}$ min
 (3) 9hrs. $23\frac{9}{11}$ min (4) None of these
6. How many degrees will the minute-hand move, in the same time in which the second hand moves 300° ?
 (1) 6° (2) 5°
 (3) 4° (4) 10°
7. A boy observes the reflection of a wall clock in a mirror. The time observed by the boy in the mirror is 3 hours 45 minutes. What is the actual time shown in the clock?
 (1) 8 hours 45 minutes (2) 9 hours 45 minutes
 (3) 8 hours 15 minutes (4) 9 hours 15 minutes
8. If a wall clock shows 9 hours 30 minutes, what time does it show in the mirror?
 (1) 2 hours 30 minutes (2) 3 hours 30 minutes
 (3) 9 hours 30 minutes (4) None of the above
9. At what time between 6 O'clock and 7 O'clock are the two hands of a clock opposite in direction?
 (1) 6 hrs. $5\frac{11}{14}$ min. (2) 6 hrs. $15\frac{11}{14}$ min.
 (3) 6 hrs. $50\frac{11}{14}$ min. (4) None of these
10. A clock is set to show the correct time at 4:00 p.m. The clock loses 12 minutes in 48 hours. What will be the true time when the clock indicates 6:00 p.m. the next day?
 (1) 6:06 p.m. (2) 6:10 p.m.
 (3) 6:20 p.m. (4) 6:12 p.m.
11. There are two clocks on a wall, both set to show the correct time at 10 a.m. Both the clocks gain $\frac{1}{2}$ and 1 minute respectively in an hour. If the clock which gains $\frac{1}{2}$ minute in 1 hour shows 10 p.m., what time does the other watch show?
 (1) 9:48 p.m. (2) 9:56 p.m.
 (3) 10:06 p.m. (4) None of these
12. There are two clocks on a wall, both set to show the correct time at 5:00 a.m. One clock loses one minute in an hour while the other gains one minute in an hour. By how many minutes do the two clocks differ at 10:00 p.m.?
 (1) 30 minutes (2) 15 minutes
 (3) 17 minutes (4) 34 minutes
13. A watch which gains 10 seconds in 5 minutes was set right at 9:00 a.m. When the watch indicated 20 minutes past 7 O'clock the same evening, the true time is
 (1) 7:00 p.m. (2) 7:40 p.m.
 (3) 7:10 p.m. (4) 8:00 p.m.
14. A clock is set to show the correct time at 11:00 a.m. The clock gains 12 minutes in 12 hours. What will be the true time when the watch indicates 1:00 p.m. on the 6th day?
 (1) 10:00 a.m. (2) 11:00 a.m.
 (3) 12:00 noon (4) None of these
15. A clock is set to show the correct time at 6:00 a.m. The clock loses 12 minutes in 24 hours. What will be the true time when the clock indicates 5:00 a.m. after 3 days?
 (1) 57 minutes past 5:00 a.m.
 (2) 3 minutes past 6:00 a.m.
 (3) 48 minutes past 5:00 a.m.
 (4) 12 minutes past 6:00 a.m.
16. A watch, which gains uniformly, was observed to be 5 minutes slow at 12 noon on a Sunday. On the subsequent Wednesday at 6:00 p.m. it was noticed

that the watch was 5 minutes fast. When did the watch show the correct time?

- (1) On Monday at 12 noon
- (2) On Monday at 3:00 a.m.
- (3) On Tuesday at 3:00 a.m.
- (4) On Tuesday at clock midnight

17. A clock is set to show the correct time at 9:00 a.m. The clock gains 10 minutes in a day. What will be the true time when the watch indicates 2:00 p.m. the next day?

- (1) 48 minutes past 1:00 p.m.
- (2) 12 minutes past 1:00 p.m.
- (3) 48 minutes past 10:00 a.m.
- (4) None of the above

18. A watch which gains uniformly, was observed to be 6 minutes slow at 6 p.m. on Monday. It was noticed 12 minutes fast at 6 a.m. the following Monday morning. When did the watch show the correct time?

- (1) Wednesday 10:00 p.m.
- (2) Thursday 10:00 a.m.
- (3) Tuesday 10:00 p.m.
- (4) None of the above

19. A watch showed 5 past 5 O'clock on Wednesday evening when the correct time was 5:00 p.m. It loses uniformly and was 5 minutes slow after two days, at 7:00 p.m. When did the watch show the correct time?

- (1) Thursday 5 p.m. (2) Thursday 6 a.m.
- (3) Thursday 6 p.m. (4) Thursday 6.30 p.m.

20. A watch which loses uniformly was observed to be 10 minutes fast at 8:00 a.m. on the 17th of a month. It showed 20 minutes less than the correct time at 8:00 p.m. on the 24th of the same month. When did the watch show the correct time?

- (1) On 19th at 8:00 p.m.
- (2) On 21st at 8:00 a.m.
- (3) On 20th at 9:00 a.m.
- (4) None of these

21. How many odd days are there in 382 days?

- (1) 1 (2) 2
- (3) 3 (4) 4

22. If today is Sunday, then what day of the week will be the 426th day from today?

- (1) Saturday (2) Friday
- (3) Tuesday (4) Wednesday

23. If today is Wednesday, what day will it be, 1 year and 10 days from today?

- (1) Sunday (2) Friday
- (3) Monday
- (4) Cannot be determined

24. Which among the following years is a leap year?

- (1) 2600 (2) 2700
- (3) 2800 (4) 3000

25. If 22 April, 1982 was a Thursday, then what day of the week was 3 November, 1982?

- (1) Monday (2) Wednesday
- (3) Friday (4) Sunday

26. If holidays are declared only on Sundays and 19 March in a particular year was a Sunday, is 23 September a holiday in that year?

- (1) Yes, 23 September is a holiday.
- (2) 23 September is not a holiday.
- (3) 23 September is a holiday only if it is a leap year.
- (4) Cannot be determined

27. I met my friend on 3 April, 1995 which was a Monday and promised to meet him again in the month of October in the same year—but only on a Sunday. On which of the following days could I meet my friend?

- (1) 7th, 14th, 21st, 28th
- (2) 1st, 8th, 15th, 22nd, 29th
- (3) 2nd, 9th, 16th, 23rd, 30th
- (4) 3rd, 10th, 17th, 24th, 31st

28. If the first day of the year 2005 is a Saturday, then what day of the week will be 1 January, 2009?

- (1) Thursday (2) Friday
- (3) Sunday (4) Monday

29. If 26 February, 2014 is on Wednesday, then what day of the week is on 14 July, 2017?

- (1) Friday (2) Saturday
- (3) Wednesday (4) Sunday

30. If 1 January, 2012 is on Sunday, then what day of the week is 1 January, 2016?

- (1) Friday (2) Sunday
- (3) Wednesday (4) Saturday

31. What day of the week will 1 January, 2018 be, given that 1 January, 2012 is a Saturday?

- (1) Monday (2) Saturday
- (3) Sunday (4) Friday

32. If 4 August, 1996 was a Sunday, then what day of the week was 12 April, 1992?
 (1) Friday (2) Saturday
 (3) Monday (4) Sunday
33. If 10th April, 1963 was a Wednesday, then what day of the week was 23rd August, 1959?
 (1) Sunday (2) Monday
 (3) Friday (4) Tuesday
34. On which dates of March, 2008 will a Sunday come?
 (1) 2, 9, 16, 23, 30 (2) 1 8, 15, 22, 29
 (3) 7, 14, 21, 28 (4) 3, 10, 17, 24, 31
35. If August 15th, 2003 is on Friday, then on which day of the week would the Independence day be celebrated in the year 2103?
 (1) Tuesday (2) Wednesday
 (3) Friday (4) Sunday
36. What day of the week was 18 July, 1978?
 (1) Sunday (2) Monday
 (3) Tuesday (4) Friday
37. What day of the week would be 26 March, 2023?
 (1) Sunday (2) Monday
 (3) Tuesday (4) Friday
38. Two days ago my father told me, "my friend is going to visit us on the seventh day from today". If the day on which my father's friend is going to visit us is Thursday, which day of the week is today?
 (1) Monday (2) Thursday
 (3) Saturday (4) Tuesday
39. A doctor asked a patient to take one dose of the medicine on the day the patient consulted the doctor, a second dose after seven days, a third dose three days after that and the last dose one day after the third dose. If the patient consulted the doctor on a Friday, on which day of the week will the patient take the last dose?
 (1) Wednesday
 (2) Friday
 (3) Monday
 (4) Tuesday
40. Ravi started a work and completed it after nine days. Ramesh started a similar work three days after Ravi has started and completed it on a Wednesday. If Ravi has completed the work two days after Ramesh has completed the work, on which day did Ravi start the work?
 (1) Wednesday (2) Monday
 (3) Tuesday (4) Thursday

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. How many degrees does an hour-hand move in 10 minutes?
 (1) 10° (2) 20°
 (3) 15° (4) 5°
2. How many degrees will the minute-hand move, in the same time, in which the hour-hand moves 10° ?
 (1) 40° (2) 80°
 (3) 120° (4) 160°
3. At what angle are the hands of a clock inclined at 4 hours 20 minutes?
 (1) 5° (2) 10°
 (3) 20° (4) 25°
4. What is the angle between the two hands of a clock, when the clock shows 3 hours 25 minutes?
 (1) $45\frac{1}{2}^\circ$ (2) 46°
 (3) $46\frac{1}{2}^\circ$ (4) $47\frac{1}{2}^\circ$
5. At what angle are the hands of a clock inclined at 20 minutes past 7?
 (1) 80° (2) 90°
 (3) 100° (4) 120°
6. What is the angle between the two hands of a clock, when the time is 2 hours 35 minutes?
 (1) $122\frac{1}{2}^\circ$ (2) $142\frac{1}{2}^\circ$
 (3) $132\frac{1}{2}^\circ$ (4) $116\frac{1}{2}^\circ$
7. At what time between 6 and 7 O'clock, are the hands of a clock together?
 (1) 6 hours $32\frac{8}{11}$ minutes
 (2) 6 hours $33\frac{6}{11}$ minutes
 (3) 6 hours $34\frac{5}{11}$ minutes
 (4) 6 hours $29\frac{7}{11}$ minutes

8. At what time between 3 and 4 O'clock are the hands of a clock in the opposite direction?
- 3 hours $48\frac{6}{11}$ minutes
 - 3 hours $49\frac{1}{11}$ minutes
 - 3 hours $50\frac{4}{11}$ minutes
 - 3 hours $47\frac{2}{11}$ minutes
9. The angle between the two hands of a clock is 70° , when the hour hand is between 7 and 8. What time does the watch show?
- 7 hours $50\frac{10}{11}$ minutes
 - 7 hours $25\frac{5}{11}$ minutes
 - 7 hours $42\frac{8}{11}$ minutes
 - Both (1) and (2)
10. What time does the clock show when the hour hand is between 3 and 4 and the angle between the two hands of the clock is 50° ?
- $8\frac{5}{11}$ min past 3
 - $25\frac{5}{11}$ min past 3
 - $24\frac{6}{11}$ min past 3
 - Both (1) and (2)
11. The time on the watch is 4:30. If the minute hand points towards the south, the hour hand will point towards
- South-east
 - East
 - West
 - North-west
12. A boy observes the reflection of a wall clock in a mirror. The time observed by the boy in the mirror is 4 hours 20 minutes. What is the actual time shown on the clock?
- 7 hours 15 minutes
 - 7 hours 50 minutes
 - 7 hours 40 minutes
 - 7 hours 35 minutes
13. If the time in a clock is 7 hours 15 minutes, then what time does it show on the mirror?
- 4 hours 50 minutes
 - 4 hours 40 minutes
 - 4 hours 35 minutes
 - 4 hours 45 minutes
14. There are two clocks on a wall, both set to show the correct time at 8 a.m. One clock loses two minutes in an hour while the other gains one minute in one hour. By how many minutes do the two clocks differ at 12 noon on the same day?
- 6 minutes
 - 9 minutes
 - 12 minutes
 - 15 minutes
15. A clock is set to show the correct time at 8:00 a.m. The clock gains 10 minutes in a day. What will be the approximate time, when the watch indicates 4:00 p.m. the next day?
- 3 hours 36 minutes
 - 3 hours 47 minutes
 - 3 hours 50 minutes
 - 3 hours 54 minutes
16. There are two clocks on a wall, both set to show the correct time at 12 noon. Both the clocks gain 1 minute and 2 minutes respectively in an hour. If the clock which gains 1 minute in one hour shows the time as 8 minutes past 8:00 p.m. on the same day, then what time does the other watch show?
- 8 hours 4 minutes
 - 8 hours 8 minutes
 - 8 hours 16 minutes
 - 7 hours 52 minutes
17. A watch, which loses uniformly was observed to be 12 minutes fast at 4:00 a.m. on 6th of a month. It showed 20 minutes less than the correct time at 6 p.m. on the 10th of the same month. When did the watch show the correct time?
- 9:15 p.m. on the 7th.
 - 9:5 a.m. on the 8th.
 - 9:35 p.m. on the 9th.
 - 9:20 p.m. on 7th.
18. A watch, which gains uniformly, was observed to be 4 minutes, slow at 6:00 a.m. on a Monday. On the subsequent Thursday at 7:00 p.m. it was noticed that the watch was 6 minutes fast. When did the watch show the correct time?
- 5:00 p.m. Tuesday
 - 4:00 p.m. Tuesday
 - 6:00 p.m. Tuesday
 - 3:00 p.m. Tuesday
19. A watch, which gains uniformly, was observed to be 5 minutes slow at 12 noon on Monday. It was noticed 10 minutes fast at 6 p.m. on the next day. When did the watch show the correct time?
- 9:00 p.m., on the same day.
 - 9 hours 30 minutes p.m., on the same day.
 - 10 hours 30 minutes p.m., on the same day.
 - 10:00 p.m., on the same day
20. A watch showed 5 minutes past 3 O'clock on Sunday evening when the correct time was 3 O'clock. It loses uniformly and was observed to be 10 minutes slow on the subsequent Tuesday at 9:00 p.m. When did the watch show the correct time?
- 8:00 a.m. Monday
 - 10:00 a.m. Monday

- (3) 7:00 a.m. Monday
(4) 9:00 a.m. Monday
21. If today is Monday, what day will it be 350 days from today?
(1) Sunday
(2) Monday
(3) Tuesday
(4) None of these
22. If today is Tuesday, what day will it be after 1 year and 150 days from today?
(1) Monday
(2) Wednesday
(3) Friday
(4) Cannot be determined
23. If 8 March, 1985 was a Friday, then what day of the week was 26 July, 1985?
(1) Monday (2) Tuesday
(3) Thursday (4) Friday
24. If 30 June, 1991 was a Sunday, then what day of the week was 7 April, 1992?
(1) Sunday (2) Monday
(3) Tuesday (4) None of these
25. If 19 September, 1995 was a Tuesday, then what day of the week was 16 November, 1997?
(1) Tuesday (2) Wednesday
(3) Friday (4) Sunday
26. If 10 August, 1991 was a Saturday, then what day of the week will this day be after 3 years?
(1) Wednesday (2) Thursday
(3) Friday (4) None of these
27. If 4 May, 1992 was a Monday, then what day of the week was 1 January, 1991?
(1) Friday (2) Thursday
(3) Tuesday (4) Monday
28. If 1 January, 1997 was a Wednesday, then what day of the week was 1 January, 1996?
(1) Sunday (2) Tuesday
(3) Thursday (4) Monday
29. If 31 July, 1997 was a Thursday, then what day of the week was 30 June, 1996?
(1) Friday (2) Sunday
(3) Wednesday (4) None of these
30. If 16 January, 1980 was a Wednesday, then what day of the week was 16 January, 1981?
(1) Saturday
(2) Friday
(3) Tuesday
(4) Sunday
31. On what day of the week did India celebrate its first Republic Day, i.e., 26 January, 1950?
(1) Sunday (2) Tuesday
(3) Thursday (4) None of these
32. What day of the week will 1 January, 2008 be, given that 1 January 2000 is a Saturday?
(1) Sunday (2) Wednesday
(3) Tuesday (4) None of these
33. What day of the week was 18 March, 1924 given that 1 October, 1987 was a Thursday?
(1) Sunday (2) Friday
(3) Saturday (4) None of these
34. Which will be the next leap year after 2096?
(1) 2100 (2) 2102
(3) 2104 (4) 2108
35. If 20 January, 2000 was a Thursday, then what day of the week was 26 February, 1997?
(1) Tuesday (2) Sunday
(3) Wednesday (4) Thursday
36. If 30 June, 1989 was a Friday, then what day of the week was 17 September, 1993?
(1) Monday (2) Wednesday
(3) Friday (4) Sunday
37. I met one of my school friends in America on 16 August, 1997 which was a Saturday and promised to meet him again in the month of December, 1999, but only on a Sunday. On which of the following dates can I meet my friend?
(1) 24 December, 1999
(2) 26 December, 1999
(3) 27 December, 1999
(4) None of the above
38. Imagine that in a calendar year, there were 436 days and 9 days in a week, then how many odd days will be there in that year?
(1) 1 (2) 2
(3) 3 (4) 4

39. Kavya was born two years after Kavita was born, who was born five years before Kumari was born, who was born three years after Komali was born, who was born eight years before Karuna was born. What is the difference between the ages of Kavya and Karuna?

(1) 8 years

(2) 10 years

(3) 5 years

(4) 6 years
40. In a city, market remains closed on every Sunday and on all public holidays. Market remains open on all other days. Suresh who arrived in the city noticed that the markets are closed on 3rd day, 6th day and on 13th day after his arrival. On which day of the week did he arrive in the city?

(1) Monday

(2) Wednesday

(3) Sunday

(4) Saturday

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 4 | 4. 3 | 5. 4 | 6. 2 | 7. 3 | 8. 1 | 9. 4 | 10. 1 |
| 11. 3 | 12. 4 | 13. 1 | 14. 2 | 15. 3 | 16. 3 | 17. 1 | 18. 1 | 19. 3 | 20. 1 |
| 21. 4 | 22. 1 | 23. 4 | 24. 3 | 25. 2 | 26. 2 | 27. 2 | 28. 1 | 29. 1 | 30. 1 |
| 31. 3 | 32. 4 | 33. 1 | 34. 1 | 35. 2 | 36. 3 | 37. 1 | 38. 3 | 39. 4 | 40. 1 |

PRACTICE EXERCISE 4 (B)

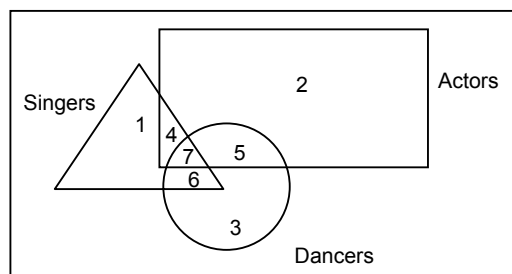
- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 2 | 4. 4 | 5. 3 | 6. 3 | 7. 1 | 8. 2 | 9. 4 | 10. 2 |
| 11. 1 | 12. 3 | 13. 4 | 14. 3 | 15. 2 | 16. 3 | 17. 1 | 18. 2 | 19. 4 | 20. 4 |
| 21. 2 | 22. 4 | 23. 4 | 24. 3 | 25. 4 | 26. 1 | 27. 3 | 28. 4 | 29. 2 | 30. 2 |
| 31. 3 | 32. 3 | 33. 4 | 34. 3 | 35. 3 | 36. 3 | 37. 2 | 38. 4 | 39. 1 | 40. 4 |
-

Venn Diagrams

Venn Diagrams are diagrammatic representation of sets, using geometrical figures like circles, triangles, rectangles, etc. Each geometrical figure represents a group as shown in the examples. The area common to two or more figures represent those elements which are common to two or more groups. There are various models in Venn Diagrams which we will discuss with examples.

VENN DIAGRAM – TYPE I

In these kind of questions, there are many geometrical figures representing different groups. Let's discuss this type with the help of the following example.



This diagram consists of three groups - Singers, Actors and Dancers, represented by a triangle, a rectangle and a circle respectively. There are seven regions represented

by numbers from 1 to 7 where each region represents the following.

- Region 1 → represents only Singers
- Region 2 → represents only Actors
- Region 3 → represents only Dancers
- Region 4 → represents those Singers who are only Actors
- Region 5 → represents those Actors who are Dancers only
- Region 6 → represents those Dancers who are Singers only
- Region 7 → represents those Singers who are Actors and Dancers

Hence, the various areas, as shown, represent different varieties, i.e., region 6 represents those Singers who are only Dancers, as region 6 is the intersection of the triangle and the circle, but not the square. You may be asked questions like “Which region represents Dancers who are only Singers?” The answer to this question, as explained above, will be region 6.

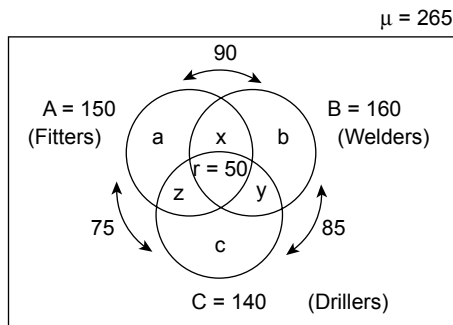
VENN DIAGRAM – TYPE II

In this type, two, three or four different groups could be given with some elements common to two or more groups. Let us observe the diagram given below.

Solved Examples

1. In a workshop there are 265 workers, out of which the total number of Fitters, Welders, and Drillers is 150, 160 and 140, respectively. There are 90 Fitters and Welders, 85 Welders and Drillers and 75 Drillers and Fitters as well as Welders.

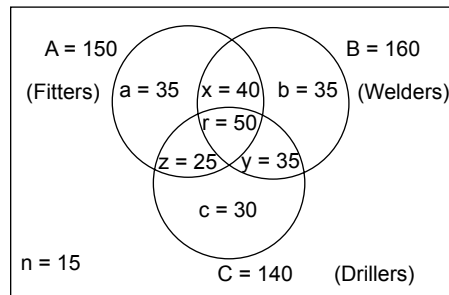
Solution: Based on the information given, we get the following diagram.



Now, $x = 90 - 50 = 40$; $y = 85 - 50 = 35$;
 $z = 75 - 50 = 25$

Also, $a = 150 - (x + r + z)$
 $= 150 - (40 + 50 + 25) = 35$
 $b = 160 - (x + r + y)$
 $= 160 - (40 + 50 + 35) = 35$
 $c = 140 - (z + r + y)$
 $= 140 - (25 + 50 + 35) = 30$

Hence, we get the following diagram:



Now, $A \text{ or } B \text{ or } C = (a + b + c) + (x + y + z) + r$
 $= 150 + 35 + 35 + 30 = 250$

Now, we can answer the questions of the following nature.

- a. What is the total number of people who are neither Fitters, nor Welders nor Drillers?

Solution: $n = \mu - (A \text{ or } B \text{ or } C) = 265 - 250 = 15$

- b. How many workers are not Fitters?

Solution: $\text{not } A = \mu - A = b + y + c + n = 35 + 35 + 30 + 15 = 115$

- c. How many fitters are not welders.

Solution: $A \text{ but not } B (A - B) = a + z$ (i.e., the regions of A excluding B) $= 35 + 25 = 60$

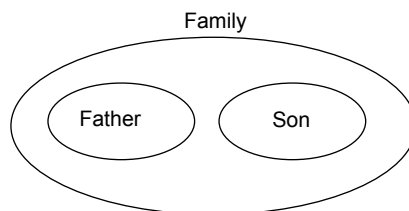
- d. How many fitters are welders but not both.

Solution: $A \text{ or } B \text{ but not } A \text{ and } B = (a + z) + (b + y)$
 $= (35 + 25) + (35 + 35) = 130$

VENN DIAGRAM TYPE – III

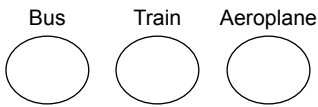
In this type, Venn diagrams are used to establish relationships between the given groups. In other words, two or more groups are given and the Venn diagram, which most correctly establishes a relation between them, has to be chosen out of the various Venn diagrams given in the choices. Let us look at some of the examples given below.

- a. Family, Father, Son:



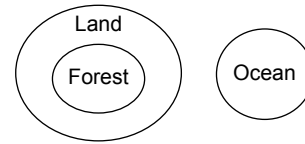
Here, a family consists of many members, to which father and son belong. The above diagram most appropriately represents these relations.

- b. Bus, Train, Aeroplane:



As there is nothing in common between these three different modes of transports, hence they should be disjoint (non-intersecting) sets. No set should be a subset of any other set.

- c. Land, Ocean, Forest:



Land and Ocean are distinct, but forest is in land or forest is subset of land. Hence, the given diagram is the most appropriate representation of the given groups. Based on the above models, solve the questions given in the exercise.

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 4: These questions are based on the following information.

In a survey, it was found that 80 youngsters in a locality liked only Cricket. 45% of the youngsters liked only Football. 5% of the youngsters liked both Cricket and Football. 10% of the youngsters liked neither Cricket nor Football.

1. How many youngsters like exactly one game?

(1) 90	(2) 180
(3) 170	(4) 200
2. How many youngsters do not like any of the two games?

(1) 10	(2) 20
(3) 90	(4) 70
3. How many youngsters like only Football?

(1) 80	(2) 100
(3) 300	(4) 90
4. How many youngsters like at least one game?

(1) 20	(2) 180
(3) 200	(4) 90

Directions for questions 5 to 8: These questions are based on the following information.

In a meeting, there are 100 politicians. Among them 35 are RK party supporters, 45 are JS party supporters and 20 support both the parties.

5. How many politicians do not support any of the two parties?

(1) 40	(2) 45
(3) 35	(4) 25
6. How many politicians support at least one party?

(1) 55	(2) 60
(3) 80	(4) 45
7. How many politicians support JS party only?

(1) 20	(2) 80
(3) 35	(4) 25
8. How many politicians are not the supporter of only one party?

(1) 80	(2) 60
(3) 35	(4) 65

Directions for questions 9 to 12: Study the following data and the table to answer the questions that follow.

A survey was conducted among 100 students in a class who read detective novels written by Conan Doyle or Agatha Christie or both. Due to some recording error in the computer most of the figures were missing. The following table shows the remaining data.

	Doyle	Christie	Both	Total
Male				
Female	40			
Total		70		100

Further, it is known that

- (1) 37% of the students read both Doyle and Christie.
 - (2) The ratio of males to females is 1 : 1.
 - (3) 50% of the females read books of both the authors.
9. How many males read books by both the authors?

(1) 10	(2) 12
(3) 37	(4) 45
 10. How many students read books by only Christie?

(1) 70	(2) 10
(3) 33	(4) 23
 11. How many females read books by only Doyle?

(1) 25	(2) 40
(3) 35	(4) 15
 12. How many students do not read books by both the authors?

(1) 12	(2) 27
(3) 37	(4) 63

Directions for questions 13 to 16: These questions are based on the following information.

In a marriage party, ice creams of three different flavours Vanilla, Strawberry and Chocolate are served. Among the guests, 100 guests have eaten Vanilla ice cream, 150 guests have eaten Strawberry ice cream and 170 guests have eaten Chocolate ice cream. 50 guests have eaten Vanilla and Strawberry ice creams. 60 guests have eaten chocolate and Strawberry ice creams. 30 guests have eaten Vanilla and Chocolate ice creams. 20 guests have eaten all the three flavoured ice creams and 80 guests have not eaten any ice cream.

13. How many guests have eaten the ice creams of at least two flavours?

(1) 190 (2) 100
(3) 150 (4) 180

14. How many guests have eaten the ice creams of Vanilla and Strawberry flavours only?

(1) 20 (2) 30
(3) 40 (4) 10

15. How many guests have eaten Vanilla ice cream and Chocolate ice cream but not Strawberry ice cream?

(1) 40 (2) 30
(3) 10 (4) 20

16. How many guests have not eaten the Vanilla ice cream?

(1) 170 (2) 150
(3) 250 (4) 280

Directions for questions 17 to 20: These questions are based on the following information.

In a music centre 'Sangeet Mahal' there were cassettes belonging to the various types of music. It was found that 125 cassettes were of Pop Music, 135 cassettes were of classical Music and 95 cassettes were of Light Music. 60 cassettes had a mixture of at least two of the music types and 10 cassettes had a mixture of all the three. Every cassette in the music centre contained at least one of the above mentioned types of music.

17. How many cassettes were of exactly two types of music?

(1) 60 (2) 50
(3) 100 (4) 90

18. How many cassettes had music of at least one type?

(1) 285 (2) 225
(3) 90 (4) 205

19. If the number of cassettes of only Pop Music is equal to that of only Light Music, which is twice of the number of cassettes of only Classical Music type, then how many cassettes of only Classical Music were there?

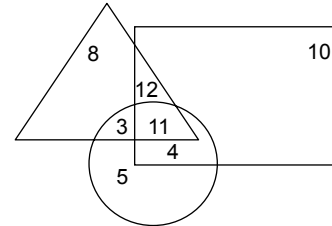
(1) 225 (2) 75
(3) 90 (4) 45

20. If the number of cassettes of only Pop Music is equal to 75 and the number of cassettes of both Pop and Classical but not Light is equal to the number of cassettes of both Pop and Light but not Classical, then how many cassettes are there in the Music Centre which are both Classical and Light but not Pop?

(1) 0 (2) 20
(3) 50 (4) 10

Directions for questions 21 to 24: These questions are based on the following diagram.

In the following figure, the Triangle represents the students who passed in Physics, the Rectangle represents the students who passed in Chemistry and the Circle represents the students who passed in Mathematics in a class.



21. How many students passed in Mathematics only?

(1) 3 (2) 5
(3) 4 (4) 11

22. How many students passed in both Chemistry and Physics?

(1) 11 (2) 12
(3) 23 (4) 15

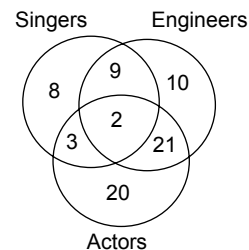
23. How many students passed in Chemistry but not in Mathematics?

(1) 22 (2) 11
(3) 18 (4) 17

24. How many students passed in Mathematic and Physics but not Chemistry?

(1) 3 (2) 4
(3) 12 (4) 11

Directions for questions 25 to 28: These questions are based on the following Venn diagram.



25. How many Actors are not Engineers?

(1) 24 (2) 23
(3) 15 (4) 18

26. How many Singers are Actors but not Engineers?

- (1) 8 (2) 3
(3) 9 (4) 21

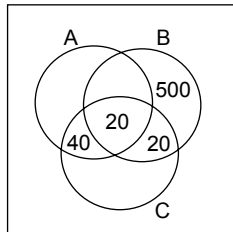
27. How many Engineers are either Singers or Actors but not both?

- (1) 25 (2) 28
(3) 35 (4) 30

28. How many Singers are Actors as well as Engineers?

- (1) 21 (2) 9
(3) 3 (4) 2

Directions for questions 29 to 32: The following Venn diagram represents the 1200 employees of a company. Each of the employees is a member of at least one of three clubs – A, B and C. Using the given data, answer the questions that follow.



Total member of club A = 420

Total member of club B = 590

Total member of club C = 340

29. How many employees are member of both club A and club B?

- (1) 50 (2) 80
(3) 70 (4) 60

30. How many employees are not member of club B?

- (1) 340 (2) 610
(3) 630 (4) 290

31. How many employees are member of club A or club C?

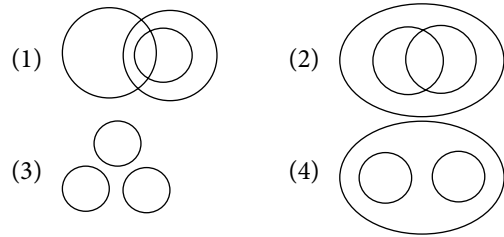
- (1) 850 (2) 700
(3) 975 (4) 675

32. How many employees are member of exactly two clubs?

- (1) 110 (2) 130
(3) 98 (4) 7

Directions for questions 33 to 36: In each question a group of words is given which can be represented by one of the four diagrams given below. Observe the diagrams carefully

and mark the number of the figure as you answer which would best represents the group of words given in each question.



33. Flowers, Marigold, Rose.

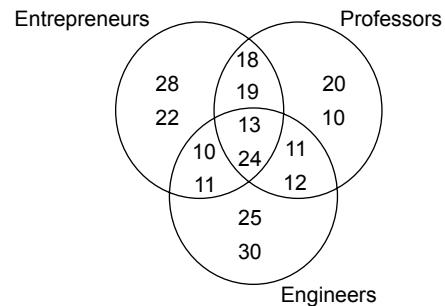
34. India, China, Australia.

35. Males, Doctors, Fathers.

36. Odd numbers, Natural numbers, Real numbers.

Directions for questions 37 to 40: These questions are based on the following Venn diagram.

In this diagram, there are two numbers in each segment, one atop the other. The number at the top represents the number of male and the number at the bottom represents the numbers of female.



37. How many Professors are neither Entrepreneurs nor Engineers?

- (1) 20 (2) 28
(3) 30 (4) 38

38. How many male Professors are not Entrepreneurs?

- (1) 29 (2) 31
(3) 49 (4) 58

39. How many females are not Engineers?

- (1) 51 (2) 48
(3) 58 (4) 60

40. How many Professors are also Entrepreneurs as well as Engineers?

- (1) 37 (2) 40
(3) 48 (4) 51

PRACTICE EXERCISE 5 (B)

Directions for questions 9 to 12: These questions are based on the following information.

In a certain locality, 44% of the residents read *Indian Express*, 35% read *The Hindu* and 43% read *The Times of India*. 10% read all the three. Also 15% read both *Indian Express* and *The Hindu*, 16% read both the *Hindu* and *The Times of India* and 17% read both *Indian Express* and *The Times of India*. 64 residents do not read any newspaper.

9. How many residents read exactly two newspapers?

- 10.** How many residents read exactly one newspaper?

11. What is percentage of the residents who read only “*The Hindu*” to those who read only “*The Times of India*”?

12. What is the ratio of the number of residents who read *The Indian Express* to that of those who read only *The Times of India*?

- In a survey conducted among 200 mobile phone using families, it was found that 140 use Panasonic, 120 use Nokia and 143 use Siemens. 95 use both Panasonic and Nokia, 85 use both Nokia and Siemens and 93 use both Panasonic and Siemens. 70 families use mobile phones of all the three companies.

- [illegible]

- (1) 63 (2) 67
(3) 70 (4) 200

- | | |
|--------|---------|
| (1) 40 | (2) 120 |
| (3) 80 | (4) 10 |

- (1) 10 (2) 70
(3) 0 (4) 20

- In a locality, three magazines are read, namely *India Today*, *Sports Star* and *Business India*. 45 people read only one magazine, 20 read exactly two magazines and 5 read all the three. There is no one who does not read any of the three magazines.

13. How many people read at least two magazines?

- (1) 25 (2) 20
 (3) 50 (4) 45

14. If the ratio of people who read *India Today* is to those who read *Sports Star* is to those who read *Business India* is 2 : 3 : 4 and 18 people read *India Today*, then how many read *Sports Star*?

- (1) 28 (2) 31
(3) 36 (4) 27

15. If 10 people stop reading *India Today* and start reading *Business India*, then what is the maximum number of people who read exactly two magazines?

(1) 20 (2) 30
(3) 25 (4) 55

16. What percentage of the people who read at least one magazine read exactly two magazines?

(1) 25% (2) 20%
(3) $28\frac{4}{7}\%$ (4) 70%

Directions for questions 17 to 20: These questions are based on the following information.

In a class of 150 students, 70 students passed in Physics and 90 passed in Statistics. 10 students failed in both the subjects.

17. How many students passed in both the subjects?

(1) 20 (2) 160
(3) 40 (4) 140

18. What percentage of students who passed in at least one subject, failed only in Statistics?

(1) 70 (2) 105
(3) 280 (4) 50

19. What percentage (approximately) of students who passed in Physics also passed in Statistics?

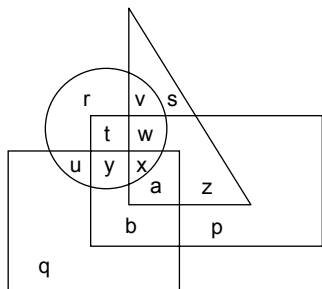
(1) 14 (2) 42
(3) 36 (4) 29

20. How many students passed in exactly one subject?

(1) 160 (2) 120
(3) 140 (4) 20

Directions for questions 21 to 24: These questions are based on the following diagram.

In the following diagram, the Circle represents all the people who like Maaza, the Square represents all the people who like Thums up, the Triangle represents all the people who like Marinda and the Rectangle represents all the people who like Coca-Cola.



21. Which of the following represents the people who like Marinda but not Thums up?

(1) v, s, w, x (2) v, s, z, a
(3) v, w, x, a (4) v, s, w, z

22. Which of the following represents the people who like Maaza and Thums up?

(1) u, t, w (2) v, w, x
(3) b, a, x (4) u, y, x

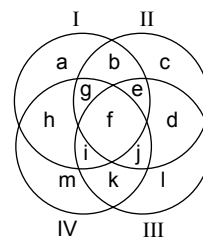
23. Which of the following represents the people who like both Maaza and Marinda but not any of other two?

(1) y (2) v
(3) u (4) b

24. Which of the following represents the people who like Marinda, Maaza, Coca-cola but not Thums up?

(1) b (2) r
(3) s (4) w

Directions for questions 25 to 28: These questions are based on the following diagram.



In the above diagram,

Circle I represents the athletes who participated in Swimming.

Circle II represents the athletes who participated in Running.

Circle III represents the athletes who participated in Javelin throw.

Circle IV represents the athletes who participated in Long jump.

25. Which of the following represents the athletes who participated in Running and Swimming?

(1) l, g, e, f (2) a, b, c
(3) g, e, f (4) b, g, e, f

26. Which of the following represents the athletes who participated in all the four events?

(1) g (2) j
(3) i (4) f

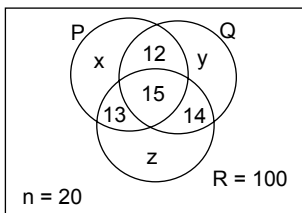
27. Which of the following represents the athletes who participated in exactly three of the four events?

- (1) h, b, k, d (2) g, e, i, j
(3) a, c, d, k (4) f, j, k, i

28. Which of the following represents the athletes who participated in Swimming and Javelin throw but not in Running?

- (1) j (2) g
(3) k (4) i

Directions for questions 29 to 32: These questions are based on the following Venn diagram.



P represents the number of students who have voter ID card.

Q represents the number of students who have Passport.

R represents the number of students who have PAN card.

n represents the number of students who do not have any of the three ID proofs i.e., Voter ID card, Passport and PAN card.

29. If the number of students who have voter ID card is half of the number of students who have PAN card then, how many students have only voter ID card?

- (1) 10 (2) 20
(3) 15 (4) 15

30. How many students have neither voter ID card nor Passport?

- (1) 64 (2) 50
(3) 78 (4) 72

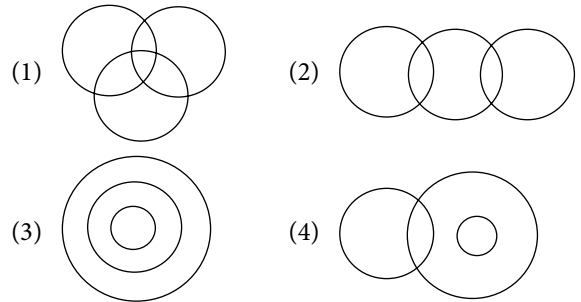
31. If $\frac{x}{y} = \frac{2}{1}$ and $\frac{y}{z} = \frac{1}{2}$ then how many students have only voter ID card?

- (1) 60 (2) 58
(3) 29 (4) 18

32. If $x = y = z$, then how many students do not have PAN card?

- (1) 120 (2) 138
(3) 160 (4) None of these

Directions for questions 33 to 36: In each question, a group of words is given which can be represented by one of the four diagrams given below. Observe the diagrams carefully and mark the number of the figure as you answer which would best represents the group of words given in each question.



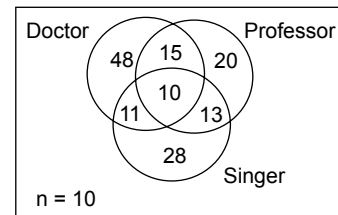
33. Beverages, Cold drinks, Coca-cola.

34. Professors, Doctors, Cardiologists.

35. Females, Doctors and Engineers.

36. Singers, Dancers, Actors.

Directions for questions 37 to 40: These questions are based on the following Venn diagram.



37. How many Professors are Doctors but not Singers?

- (1) 12 (2) 11
(3) 15 (4) 13

38. How many Singers are Doctors as well as Professors?

- (1) 15 (2) 11
(3) 13 (4) 10

39. How many Doctors are not Singers?

- (1) 50 (2) 78
(3) 79 (4) 63

40. How many persons are either Professors or Singers but not both?

- (1) 34 (2) 48
(3) 68 (4) 74

ANSWER KEYS**PRACTICE EXERCISE 5 (A)**

1. 3	2. 2	3. 4	4. 2	5. 1	6. 2	7. 4	8. 2	9. 2	10. 3
11. 4	12. 4	13. 2	14. 2	15. 3	16. 4	17. 2	18. 1	19. 4	20. 4
21. 2	22. 3	23. 1	24. 1	25. 2	26. 2	27. 4	28. 4	29. 3	30. 2
31. 2	32. 1	33. 4	34. 3	35. 1	36. 2	37. 3	38. 2	39. 1	40. 1

PRACTICE EXERCISE 5 (B)

1. 2	2. 4	3. 4	4. 3	5. 1	6. 2	7. 4	8. 3	9. 3	10. 4
11. 4	12. 2	13. 1	14. 4	15. 1	16. 3	17. 1	18. 4	19. 4	20. 2
21. 4	22. 4	23. 2	24. 4	25. 4	26. 4	27. 2	28. 4	29. 1	30. 3
31. 2	32. 4	33. 3	34. 4	35. 2	36. 1	37. 3	38. 4	39. 4	40. 4

Cubes and Dice

CUBES

A cube is a three dimensional solid having 6 faces, 12 edges and 8 corners. All the edges of a cube are equal and hence all the faces are square in shape.

Basically, in competitive exams, a few questions may be asked based on cubes.

The questions on cubes may belong to any one of the following categories.

- I. A cube is cut making certain specified cuts. The directions in which the cuts are made may or may not be

given. We are to find the number of identical pieces resulting out of the given cuts.

- II. The number of identical pieces, into which a cube is cut, is given and we need to find the cuts.
- III. A cube could be painted on all or some of its faces with the same colour or different colours and then cut into a certain specified number of identical pieces. Questions of the form — “How many small cubes have 2 faces painted?” “How many smaller cubes have only one face painted?” etc., could then be framed.

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 4: Select the correct alternative from the given choices.

1. If five cuts are made on a cube, what is the minimum number of pieces obtained?
(1) 18 (2) 6
(3) 16 (4) 25
2. If six cuts are made on a cube, what is the maximum number of identical pieces obtained?
(1) 16 (2) 18
(3) 36 (4) 27

3. If two, three and four cuts are made parallel to different faces of a cube, then what is the number of identical pieces obtained?
(1) 60
(2) 30
(3) 48
(4) 24
4. What is the minimum number of cuts required to cut a cube into 216 identical pieces?
(1) 36 (2) 18
(3) 15 (4) 12

Directions for questions 5 to 7: These questions are based on the following information.

Each of 216 small identical cubes are painted blue on all faces and all these cubes are arranged to form a large cube. Now all the faces of the large cube are painted pink.

5. How many small cubes have only one colour on them?

- (1) 96 (2) 125
(3) 64 (4) 48

6. How many small cubes have exactly two faces painted pink?

- (1) 36 (2) 48
(3) 64 (4) 80

7. How many small cubes have exactly three faces painted blue?

- (1) 8 (2) 4
(3) 2 (4) 6

Directions for questions 8 to 11: These questions are based on the following information.

216 small identical cubes are arranged to form a large cube. Now three faces of the large cube are painted yellow, of which no two faces are opposite each other. Of the remaining faces, two are painted green and the other black.

8. How many small cubes have all three colours on them?

- (1) 1 (2) 2
(3) 3 (4) 4

9. How many small cubes have exactly two colours on them?

- (1) 28 (2) 30
(3) 37 (4) 44

10. How many small cubes have exactly three faces painted in the same colour?

- (1) 0 (2) 1
(3) 2 (4) 3

11. How many small cubes have black and green but not yellow colour on them?

- (1) 8 (2) 9
(3) 10 (4) 12

Directions for questions 12 to 14: These questions are based on the following information.

A cube is painted in black and green, each on three faces such that any two faces with same colour are adjacent to each other. Now this cube is cut into 60 identical pieces using 2, 3 and 4 cuts parallel to different faces.

12. How many smaller pieces have exactly two faces painted in black?

- (1) 5 (2) 9
(3) 18 (4) 27

13. How many smaller pieces have both the colours on them?

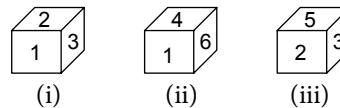
- (1) 9 (2) 18
(3) 6 (4) 24

14. How many smaller pieces have no face painted?

- (1) 6 (2) 9
(3) 11 (4) 1

Directions for questions 15 to 18: In each of the following questions, three different views of a cube are given. Based on these diagrams answer the following questions.

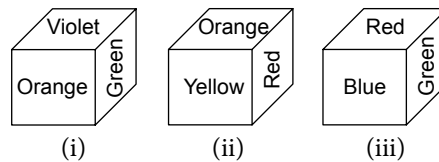
15.



Which of the following statements is true?

- (1) 3 is opposite 6 (2) 5 is opposite 4
(3) 4 is opposite 3 (4) 6 is opposite 2

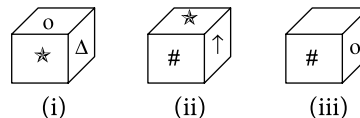
16.



Which colour is at the bottom of the second figure?

- (1) Blue (2) Green
(3) Orange (4) Red

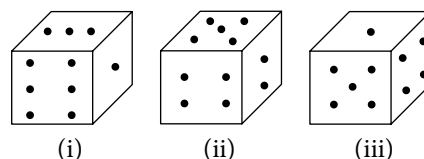
17.



Which of the following are adjacent to Δ?

- (1) *, # (2) ↑, #
(3) o, ↑ (4) o, #

18.

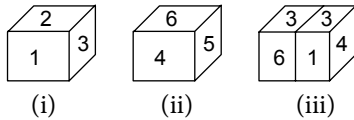


What is the sum of the dots on the two faces which are adjacent to both the faces with two dots and five dots, if the number of dots on the six faces is 1, 2, 3, 4, 5 and 6 respectively?

- (1) 10 (2) 7
(3) 5 (4) 4

Directions for questions 19 and 20: In each of the following questions, figures (i) and (ii) are two dice which are similar to each other in all respects. Figure (iii) is the view of both the dice when joined together. Answer the questions that follow based on the above information.

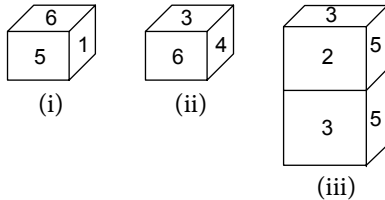
19.



What is the sum of the values on the faces of the dice that touches each other?

- (1) 7 (2) 4
(3) 6 (4) 5

20.

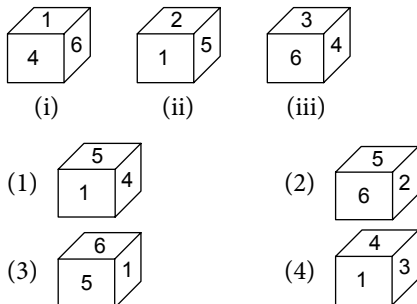


What is the sum of the values on the two faces at the back of fig. (iii)?

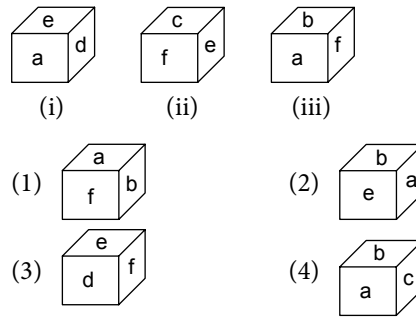
- (1) 3 (2) 4
(3) 7 (4) 6

Directions for questions 21 and 22: Each of the following questions contain three views of the same cube. Find out from the given choices, the choice which represents the correct view of the same cube.

21.

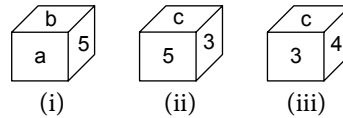


22.



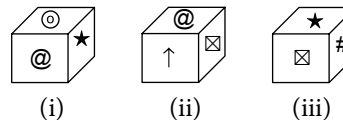
Directions for questions 23 and 24: Each of the following questions contains three different views of a dice. Study the given figures and find out the incorrect statement from the given choices.

23.



- (1) a is opposite c.
(2) 3 is opposite b.
(3) 4 is adjacent to a, b and 3.
(4) None of these

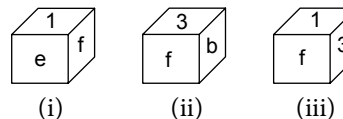
24.



- (1) # and @ are adjacent to both ★ and ↑.
(2) # and ↑ are adjacent to both ★ and @.
(3) ⊙ and ⊠ are adjacent to ★ and ↑.
(4) @ and # are adjacent to ⊙ and ⊠.

Directions for question 25: The following question contains three views of a dice. Study it and find out the correct statement from the given choices.

25.



- (1) 3-e and 1-f are opposite.
(2) 1-b and 5-3 are opposite pairs.
(3) 3-b and 5-f are opposite pairs.
(4) Data is insufficient.

Directions for questions 26 to 30: These questions are based on the following data.

There is a cube in which one pair of adjacent faces is painted red, the second pair of adjacent faces is painted blue and a third pair of adjacent faces is painted green. This cube is now cut into 216 smaller but identical cubes.

26. How many small cubes are there with no red paint at all?

(1) 144 (2) 150
(3) 125 (4) 130

27. How many small cubes are there with at least two different colours on their faces?

(1) 64 (2) 54
(3) 33 (4) 44

28. How many small cubes are there with one face painted red?

(1) 64 (2) 81
(3) 60 (4) 100

29. How many small cubes are with both red and green on their faces?

(1) 8 (2) 12
(3) 16 (4) 32

30. How many small cubes are there showing only green or only blue on their faces?

(1) 64 (2) 72
(3) 81 (4) 90

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 4: Select the correct alternative from the given choices.

1. What is the minimum number of cuts required to cut a cube into 24 identical pieces?

(1) 6 (2) 8
(3) 9 (4) 12

2. If 10 cuts are made on a cube, what is the maximum number of identical pieces obtained?

(1) 80 (2) 100
(3) 64 (4) 125

3. 27 identical cubes are arranged to form a large cube. How many such cubes are required to completely cover the large cube, so that the figure obtained also must be a cube?

(1) 125 (2) 98
(3) 64 (4) 80

4. A large cube is formed using 125 identical smaller cubes and is placed at the corner of a large room. How many such smaller cubes are required to cover the large cube completely, so that the figure obtained also must be a cube?

(1) 91 (2) 96
(3) 75 (4) 127

Directions for questions 5 to 7: These questions are based on the following information.

A cube, painted on all its faces, is cut into 125 identical smaller cubes.

5. How many smaller cubes have no face painted?

(1) 100 (2) 81
(3) 64 (4) 27

6. How many smaller cubes have only one face painted?

(1) 36 (2) 54
(3) 64 (4) 108

7. How many smaller cubes have exactly two faces painted?

(1) 36 (2) 54
(3) 48 (4) 60

Directions for questions 8 and 9: These questions are based on the following information.

Each of 125 small identical cubes are painted black on all faces and all these cubes are arranged to form a large cube. This large cube is placed at the corner of a large room and all the visible faces of this cube are painted white.

8. How many smaller cubes have at least two faces with white paint?

(1) 13 (2) 16
(3) 15 (4) 10

9. How many smaller cubes have no face painted white?

(1) 27 (2) 100
(3) 64 (4) 81

Directions for questions 10 and 11: These questions are based on the following information.

125 small identical cubes are arranged to form a large cube and it is painted in red, blue and green on two faces each,

such that any two faces with the same colour are adjacent to each other.

10. How many small cubes have only one colour on their faces?

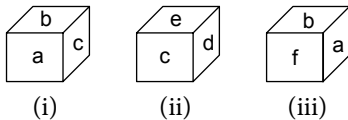
(1) 48 (2) 63
(3) 75 (4) 81

11. How many small cubes have exactly two colours on their faces?

(1) 24 (2) 27
(3) 33 (4) 39

Directions for questions 12 to 14: In each of the following questions, three different views of a cube are given. Based on these diagrams answer the following questions.

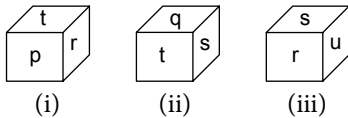
12.



Which of the following indicates the correct pair of opposite faces?

(1) a - d (2) a - f
(3) f - e (4) b - d

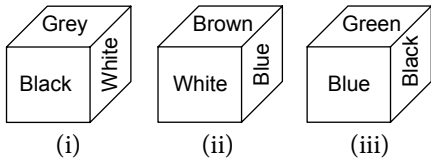
13.



Which of the following are opposite r and t respectively?

(1) u and q (2) p and s
(3) s and p (4) q and u

14.

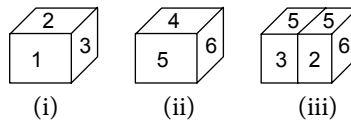


Which of the following is at the bottom of figure (i)?

(1) Blue (2) Green
(3) Black (4) Brown

Directions for questions 15 and 16: In each of the following questions, figures (i) and (ii) are two dice which are similar to each other in all respects. Figure (iii) is the view of both the dice when joined together. Answer the questions that follow based on the above information.

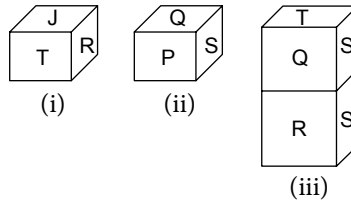
15.



What is the sum values of the faces that are joined together, if the number on the face of the dice to the left in figure (iii) which is touching the other dice is 2?

(1) 5 (2) 2
(3) 7 (4) 12

16.

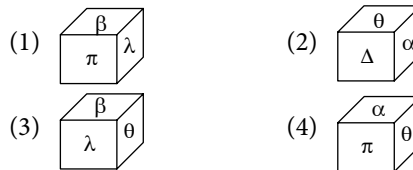
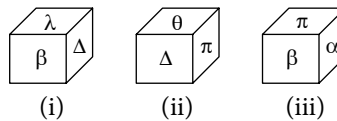


What are the letters on the top and bottom faces of the dice at the bottom in figure (iii)?

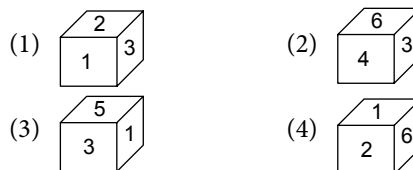
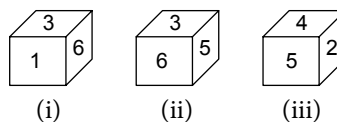
(1) Q and T (2) P and T
(3) P and Q (4) Q and J

Directions for questions 17 to 19: In each of these questions, three different views of a dice are given. Choose the answer which represents the correct view of the dice.

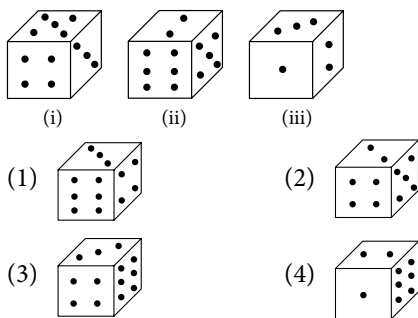
17.



18.

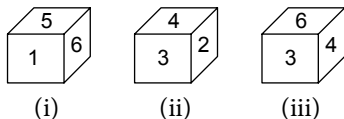


19.



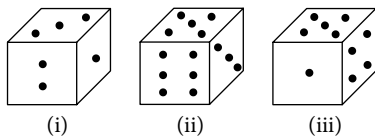
Directions for questions 20 to 22: Each of the following questions contains three different views of a dice. Study the given figures and find out the incorrect statement from the given choices.

20.



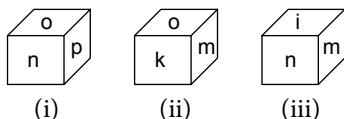
- (1) 6 is opposite 2. (2) 1 is opposite 5.
(3) 4 is opposite 1. (4) 3 is opposite 5.

21.



- (1) 5 dots are adjacent to 3, 2 and 4 dots.
(2) 2 and 5 dots are adjacent to both 3 and 4 dots.
(3) 3 and 4 dots are adjacent to both 1 and 6 dots.
(4) 1 and 6 dots are adjacent to both 2 and 5 dots.

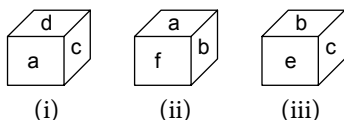
22.



- (1) l is opposite o. (2) k is opposite n.
(3) m is opposite n. (4) None of these

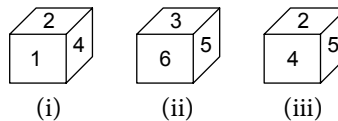
Directions for questions 23 to 25: Each of the following questions contains three views of a dice. Study them and find out the correct statement from the given choices.

23.



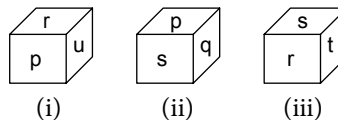
- (1) d is opposite e.
(2) a and b are adjacent to d.
(3) f is opposite d.
(4) None of these

24.



- (1) 1 is opposite 5. (2) 2 is opposite 3.
(3) 6 is opposite 4. (4) All the above

25.



- (1) r and q are adjacent to t and s.
(2) u and r are adjacent to t and s.
(3) p is adjacent to q, r, t and u.
(4) None of these

Directions for questions 26 to 30: These questions are based on the following data.

Three different faces of a cube are painted in three different colours—red, green and blue. This cube is now cut into 216 smaller but identical cubes.

26. What is the least number of the smaller cubes that will have exactly three faces painted?

- (1) 1 (2) 6
(3) 2 (4) None of these

27. How many of the smaller cubes have exactly two faces painted?

- (1) 12 (2) 15
(3) 16 (4) Either (1) or (2)

28. What are the least and the largest numbers of small cubes that have exactly one face painted?

- (1) 75 and 86 (2) 64 and 81
(3) 64 and 72 (4) 75 and 84

29. What is the least number of small cubes that have exactly one face painted red and no other face painted?

- (1) 12 (2) 18
(3) 24 (4) 36

30. What is the maximum number of small cubes that have one face painted green and one face blue and no other face painted?

- (1) 2 (2) 4
(3) 6 (4) 8

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

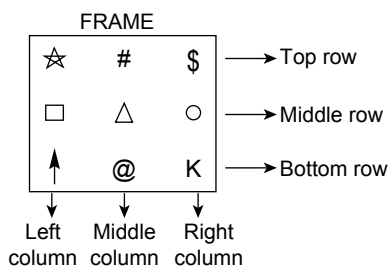
1. 2	2. 4	3. 1	4. 3	5. 3	6. 2	7. 1	8. 2	9. 3	10. 2
11. 2	12. 2	13. 2	14. 1	15. 1	16. 1	17. 3	18. 1	19. 2	20. 3
21. 3	22. 1	23. 4	24. 2	25. 4	26. 2	27. 4	28. 3	29. 3	30. 2

PRACTICE EXERCISE 6 (B)

1. 1	2. 1	3. 2	4. 1	5. 4	6. 2	7. 1	8. 1	9. 3	10. 2
11. 3	12. 4	13. 4	14. 1	15. 1	16. 2	17. 4	18. 4	19. 4	20. 2
21. 1	22. 3	23. 4	24. 4	25. 4	26. 4	27. 4	28. 4	29. 3	30. 3

Non-verbal Reasoning: Series, Odd Man Out and Analogies

These questions test the ability of the candidate to develop logic from certain abstract figures given in the question. To understand the pattern in the given figures, one should develop a systematic method of studying the figures given. These questions consist of figures given in square boxes. These boxes are referred to as frames. The figures in each frame are called elements, which are generally identified by their position in the frame.



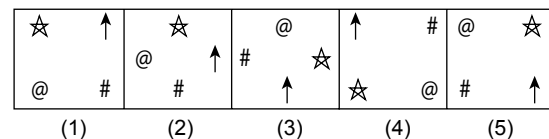
In the above frame, each element is referred to by its row and column. The element '☆' is referred to as top-left element. i.e., top row-left column. The element '△' is referred to as the central element. The behaviour of these elements, with reference to their position is studied. In certain questions, each frame contains only one big element, with certain smaller elements attached to it. These smaller elements behave following a uniform pattern.

Pattern of Behaviour of the Elements

The behaviour of elements means the changes that take place in them. These changes are classified as follows.

Shift

Shift means change in position. That is movement from one position to another. The shift is measured by the distance moved by the element with respect to its position in the immediate previous frame. The unit of measurement of distance is one side, which is equal to the distance between one corner of the frame and its adjacent corner. The following example gives a clear idea of studying the shift.

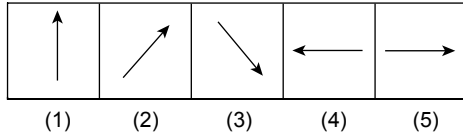


When the positions of the elements in frame 1 are compared to those of the elements in frame 2, it is clear that each element is shifted by half-a-side in the clockwise direction. From frame 2 to 3 the shift is one side, from frame 3 to 4 the shift is one and half side, from frame 4 to 5 the shift is two sides. Thus the shift is measured in

multiples of half-a-side. The shift may take place in clockwise or counter clockwise direction.

Rotation

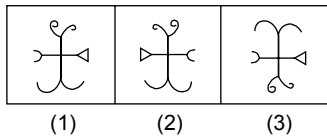
When an element changes the direction towards which it was pointing, the element is said to be rotated. Let us study the pattern of rotation in the following illustration.



In frame 1, the element is pointing towards north and in frame 2 it is pointing towards north-east. i.e., the element is rotated by 45° in clockwise direction. From frame 2 to 3, the rotation is by 90° , from frame 3 to 4 the rotation is by 135° and from frame 4 to 5 the rotation is by 180° . Thus the rotation is given in multiples of 45° . The rotation may be in clockwise or counter clockwise direction.

Image Formation

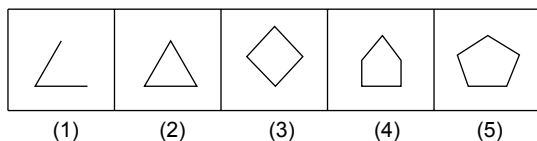
In this case, an element in a frame is represented in the form of its image in the next frame. This image could be mirror image or water image as illustrated below.



In the above diagram, frame 2 is the mirror image of frame 1 (i.e., lateral inversion) and frame 3 is the water image of frame 2 (i.e., vertical inversion).

Change in the Number of Elements

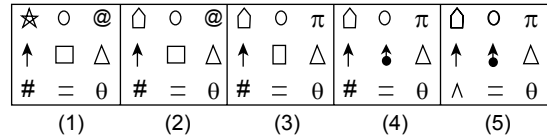
In certain questions, the number of elements either increase or decrease from one frame to the next one.



From frame 1 to 2, the number of sides decreased by 1 in the above series from one frame to another the number of sides increased by one.

Substitution

In some cases, one of the elements in the previous frame is substituted by a new element in the next frame.



In frame 2, the top-left element of frame 1 is substituted by a new element. In frame 3, the top-right element of frame 2, is substituted by a new element. In frame 4, the central element of frame 3 is substituted by a new element. In frame 5, the bottom-left element of frame 4 is substituted by a new element. i.e., every alternate element starting from the top-left element is substituted in the subsequent frame.

The question may be based on any one of the above patterns or a combination of two or more patterns.

Types of Questions

The questions can be classified into the following basic groups.

- (a) Series
- (b) Analogies
- (c) Odd man out

(A) Series: These questions are further classified as follows.

- (1) Five figure series (to find the next figure): In these questions, five problem figures followed by answer figures are given. By observing the pattern followed by the problem figures, one of the answer figures which continues the same pattern is to be chosen as the answer.
- (2) Five figure series (to find the missing figure): These questions are similar to the previous type, but in these questions one of the five problem figures is not given. One of the answer figures, which along with the other problem figures can form a logical series, is to be chosen as the answer.
- (3) Six figure series (to find the wrong figure): In these questions six figures are given. The series starts with the first figure and ends with the last figure. One of the five figures at the middle does not follow the pattern. This needs to be rectified so that a logically uniform pattern is established.

The number of that figure should be given as the answer.

- (4) **Interchange:** These questions consist of a series of figures. The figures as such do not follow a logical pattern. A logical pattern can be established by interchanging the positions of two frames. The number given to the earlier of the two frames to be interchanged should be marked as the answer. i.e., if the second and the fourth frames are to be interchanged, then the answer is 2. There may be certain questions, where no interchange is necessary. i.e., the order in which the figures are given is in a logical pattern. Then the answer to be given is 4.

(B) Analogies:

Questions based on analogies are classified as,

- (1) Four figure analogy
- (2) Similar pair
- (1) **Four figure analogy:** These questions contain two pairs of problem figures followed by four answer figures. Among the two figures in the second pair of problem figures one is not given. An answer figure should be chosen in such a way that a relation between the two figures of the second problem pair is established, which is similar to the relationship existing between the two figures of the first pair of the problem figures.
- (2) **Similar pair:** These questions contain a pair of problem figures, followed by five pairs of answer

figures. The answer pair which has a relationship between its two figures, which is similar to the relationship existing between the two figures of the problem pair, should be chosen as the answer.

(C) Odd man out:

These type of questions are given in the following ways.

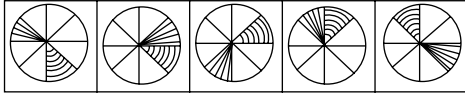
- (1) Odd man out (individual figures)
- (2) Odd pair
- (1) **Odd man out:** These questions contain four independent figures. The pattern of arrangement of the elements within a frame will be similar in three out of the four figures and it would be different in one of them. The number of that figure should be marked as the answer.
- (2) **Odd pair:** These questions contain five pairs of answer figures. The relationship between the two figures three out of the four pairs will be similar, but it would be different for one of the pair. The number of that pair should be given as the answer.

These questions may also contain problem figures along with four answer figures. The relationship existing between the two figures of the pair of problem figures can be observed in three out of the four pairs of answer figures. The pair of answer figures, which does not have such relationship between its two figures is to be chosen as the answer.

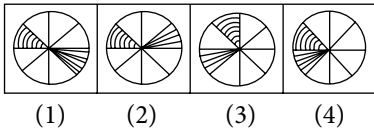
PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 8: Given below are the two sets of figures, the problem figures and the answer figures marked (1), (2), (3), and (4). Which figure from (1), (2), (3), and (4) would be the next in the series of the problem figures?

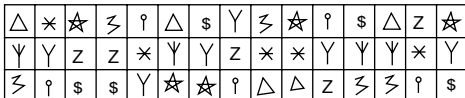
1. PROBLEM FIGURES



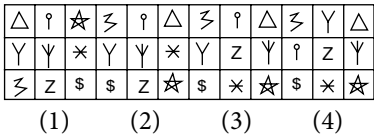
ANSWER FIGURES



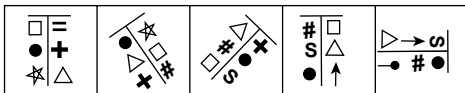
2. PROBLEM FIGURES



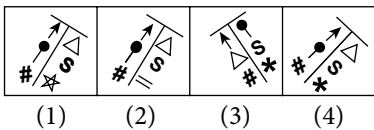
ANSWER FIGURES



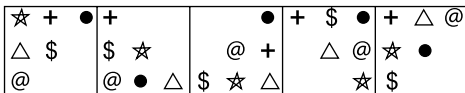
3. PROBLEM FIGURES



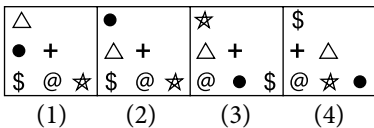
ANSWER FIGURES



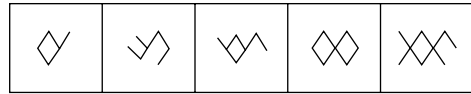
4. PROBLEM FIGURES



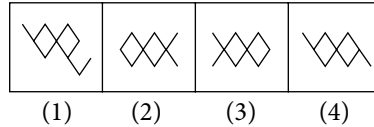
ANSWER FIGURES



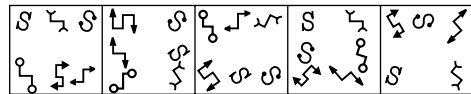
5. PROBLEM FIGURES



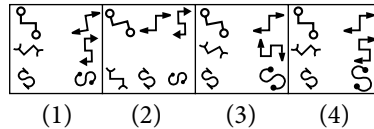
ANSWER FIGURES



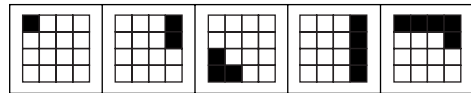
6. PROBLEM FIGURES



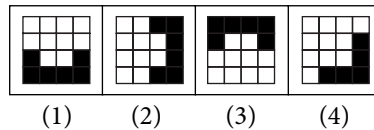
ANSWER FIGURES



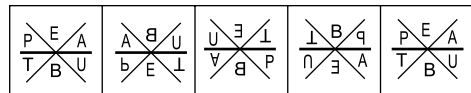
7. PROBLEM FIGURES



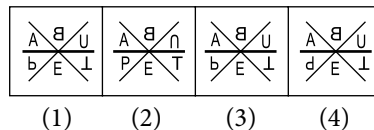
ANSWER FIGURES



8. PROBLEM FIGURES



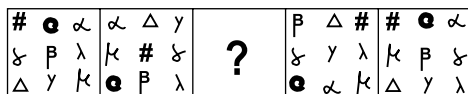
ANSWER FIGURES



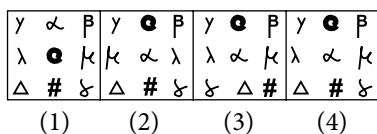
Directions for questions 9 to 11: In each of these questions, there are two sets of figures. The figures on the left are Problem Figures. (Four figures and one question marked space) and those on the right are Answer Figures indicated

by numbers 1, 2, 3, and 4. A series is established if one of the four Answer Figures is placed at the “question marked space”. Figures form a series if they change from left to right according to the same rule. The number of the Answer Figures which should be placed in the question-marked space is the answer. All the five figures i.e., four Problem Figures and one Answer Figure placed in the question marked space should be considered as forming the series.

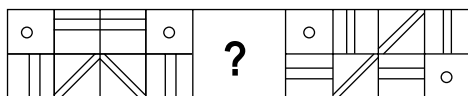
9. PROBLEM FIGURES



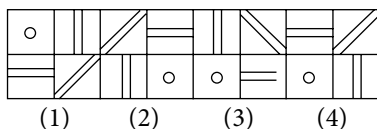
ANSWER FIGURES



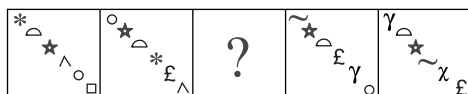
10. PROBLEM FIGURES



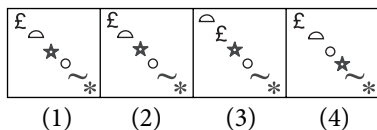
ANSWER FIGURES



11. PROBLEM FIGURES

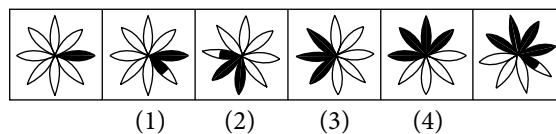


ANSWER FIGURES

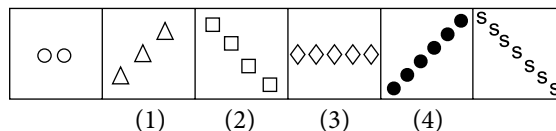


Directions for questions 12 to 14: In the following questions, a series begins with an un-numbered figure on the extreme left. One and only one of the four numbered figures does not fit into the series. The two un-numbered figures, one each on the extreme left and extreme right fit into the series. You have to take as many aspects into account as possible of the figures in the series and find out the one and only one of the four numbered figures which does not fit into the series. The number of that figure is your answer.

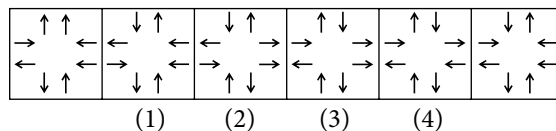
12.



13.

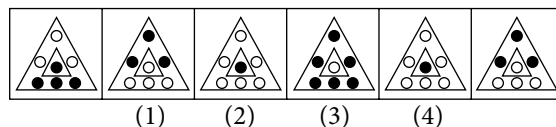


14.

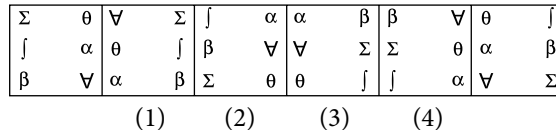


Directions for questions 15 to 17: In each of the following questions, a series starts from the left with an unnumbered figure. If the positions of two out of the five numbered figures are interchanged, the series will be established properly. The earlier of the two numbered figures whose positions are to be interchanged, will be the answer. If it is not necessary to interchange the positions of figures to establish the series, mark 4 as your answer. Now answer the following questions.

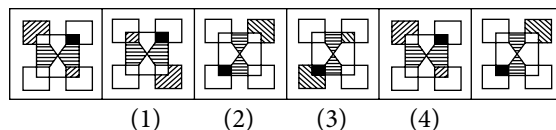
15.



16.

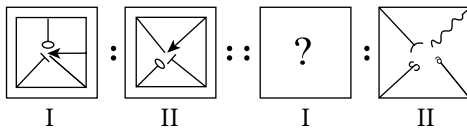


17.

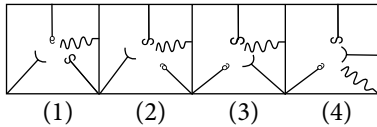


Directions for questions 18 to 22: In each of the following questions, the first two figures are related to each other in a certain way. Find out which figure from the answer figures 1, 2, 3 and 4, should be placed at the ? mark so that the second pair so formed will have a similar relationship and can be placed at “question mark”.

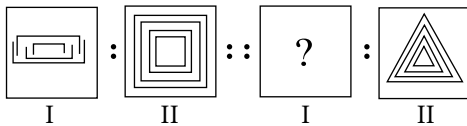
18. PROBLEM FIGURES



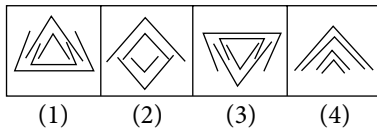
ANSWER FIGURES



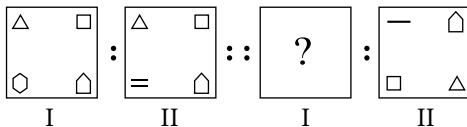
19. PROBLEM FIGURES



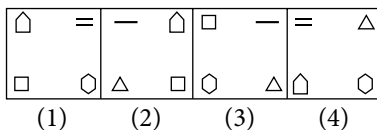
ANSWER FIGURES



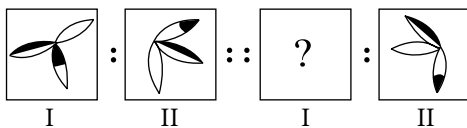
20. PROBLEM FIGURES



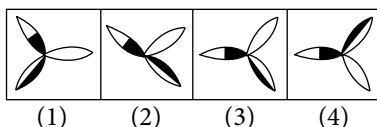
ANSWER FIGURES



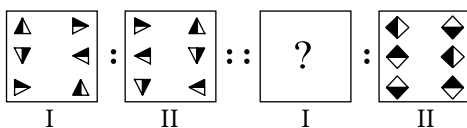
21. PROBLEM FIGURES



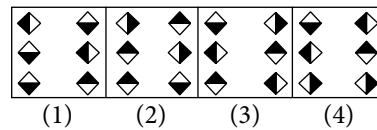
ANSWER FIGURES



22. PROBLEM FIGURES

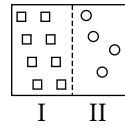


ANSWER FIGURES

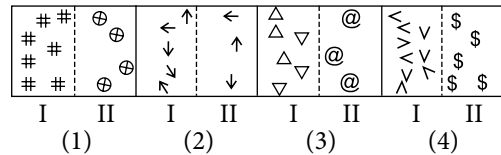


Directions for questions 23 to 27: In each of the following pair of figures given at the left extreme is followed by four pair figures. The left figure in the problem figures bears a certain relationship with the right figure. Out of the four pairs given in the answer figures. One should be similar to that pair given in the problem figure. Find that pair out.

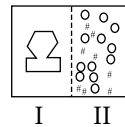
23. PROBLEM FIGURES



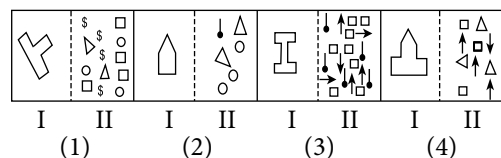
ANSWER FIGURES



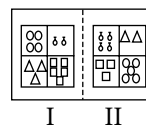
24. PROBLEM FIGURES



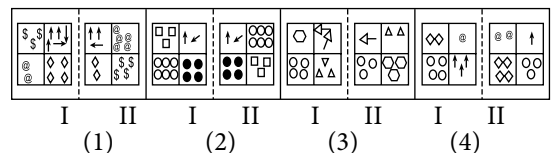
ANSWER FIGURES



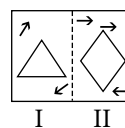
25. PROBLEM FIGURES



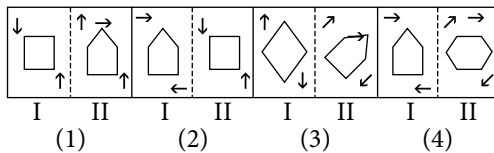
ANSWER FIGURES



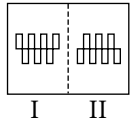
26. PROBLEM FIGURES



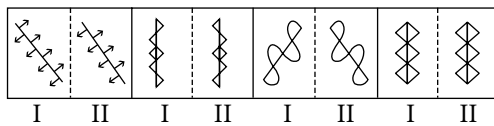
ANSWER FIGURES



27. PROBLEM FIGURES

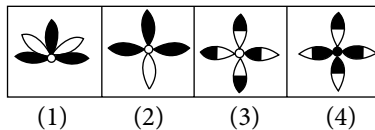


ANSWER FIGURES

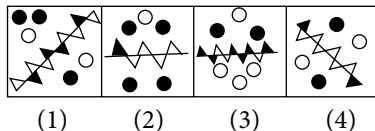


Directions for questions 28 to 32: Among the four given figures, three figures follow the same pattern and one figure is different from these three. Mark this figure (which is different from the other three) as your answer.

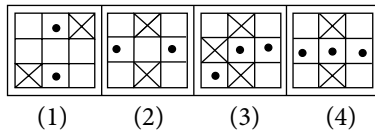
28.



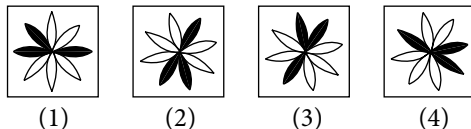
29.



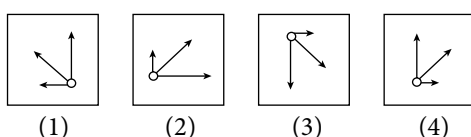
30.



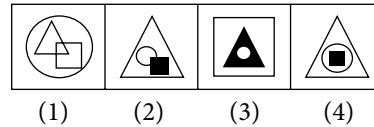
31.



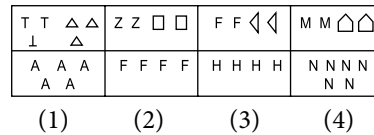
32.



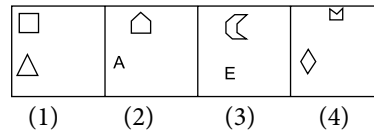
33.



34.

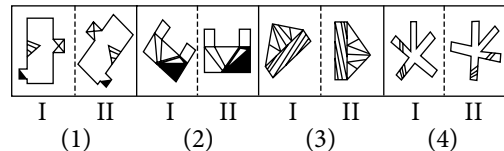


35.

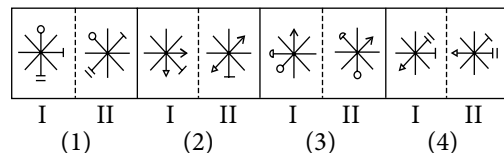


Directions for questions 36 to 40: In each of the following questions, in three out of the four figures, element II is related to element I in the same particular pattern. Find out the figure in which the element II is not so related to element I in that pattern.

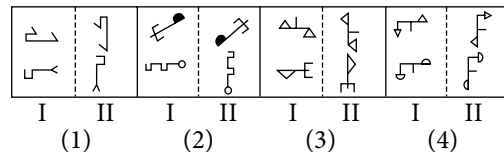
36.



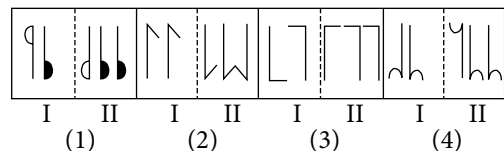
37.



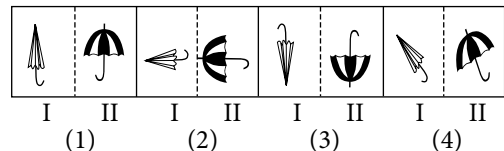
38.



39.



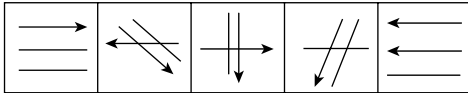
40.



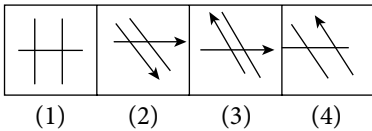
PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 9: Given below are the two sets of figures, the problem figures and the answer figures marked (1), (2), (3) and (4). Which figure from (1), (2), (3) and (4) would be the next in the series of the problem figures?

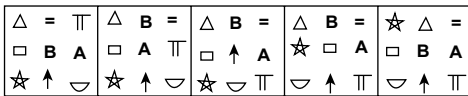
1. PROBLEM FIGURES



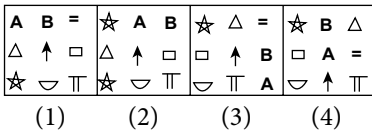
ANSWER FIGURES



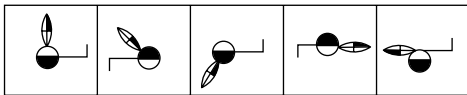
2. PROBLEM FIGURES



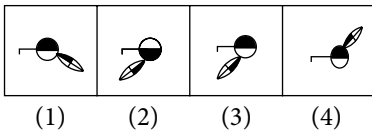
ANSWER FIGURES



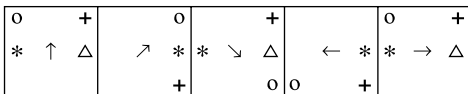
3. PROBLEM FIGURES



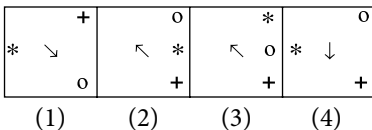
ANSWER FIGURES



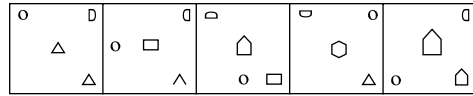
4. PROBLEM FIGURES



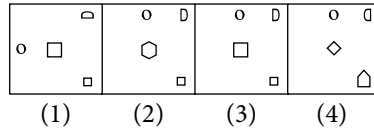
ANSWER FIGURES



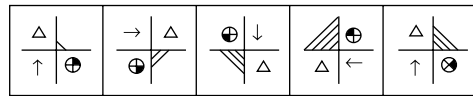
5. PROBLEM FIGURES



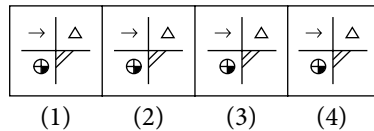
ANSWER FIGURES



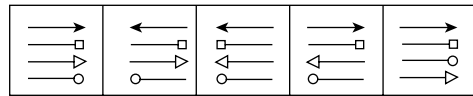
6. PROBLEM FIGURES



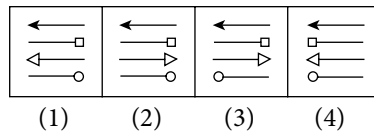
ANSWER FIGURES



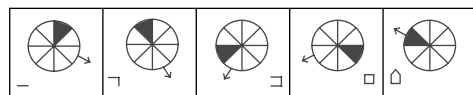
7. PROBLEM FIGURES



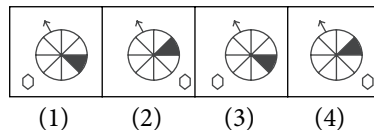
ANSWER FIGURES



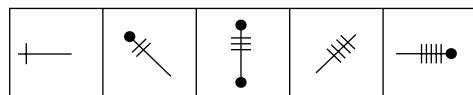
8. PROBLEM FIGURES



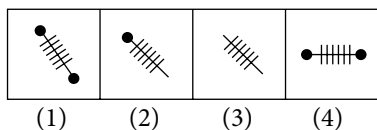
ANSWER FIGURES



9. PROBLEM FIGURES

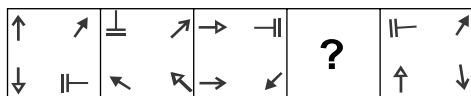


ANSWER FIGURES

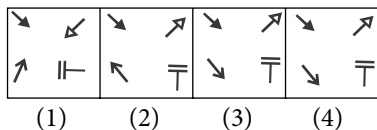


Directions for questions 10 to 12: In each of these questions there are two sets of figures. The figures on the left are Problem Figures. (Four figures and one question marked space) and those on the right are Answer Figures indicated by numbers (1), (2), (3) and (4). A series is established if one of the four Answer Figures is placed at the “question marked space”. Figures form a series if they change from left to right according to the same rule. The number of the Answer Figure which should be placed in the question-marked space is the answer. All the five figures i.e., four Problem Figures and one Answer Figure placed in the question marked space should be considered as forming the series.

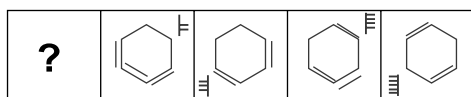
10. PROBLEM FIGURES



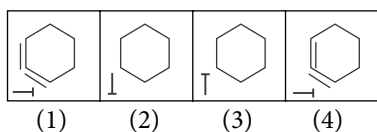
ANSWER FIGURES



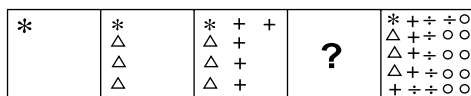
11. PROBLEM FIGURES



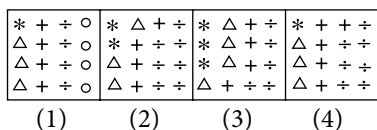
ANSWER FIGURES



12. PROBLEM FIGURES

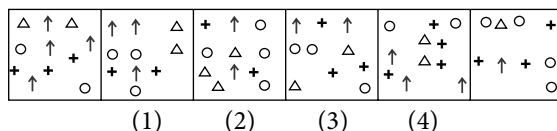


ANSWER FIGURES

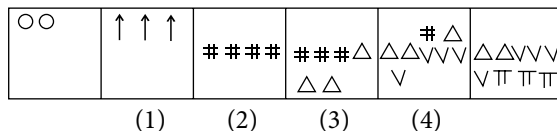


Directions for questions 13 to 15: In the following questions, a series begins with an un-numbered figure on the extreme left. One and only one of the four numbered figures does not fit into the series. The two un-numbered figures, one each on the extreme left and extreme right fit into the series. You have to take as many aspects into account as possible of the figures in the series and find out the one and only one of the four numbered figures which does not fit into the series. The number of that figure is your answer.

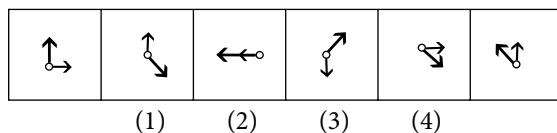
13.



14.

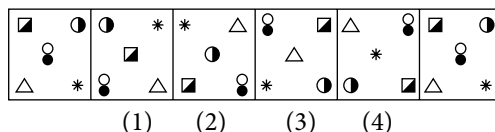


15.

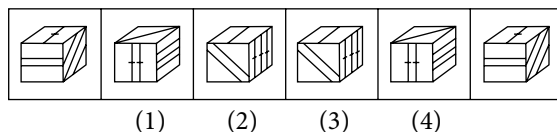


Directions for questions 16 to 18: In each of the following questions, a series starts from the left with an unnumbered figure. If the positions of two out of the four numbered figures are interchanged, the series will be established properly. The earlier of the two numbered figures whose positions are to be interchanged, will be the answer. If it is not necessary to interchange the positions of figures to establish the series, mark 4 as your answer. Now answer the following questions.

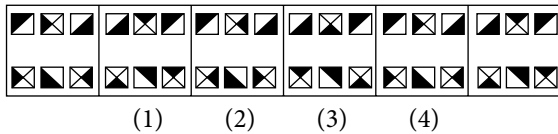
16.



17.



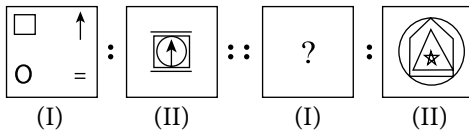
18.



(1) (2) (3) (4)

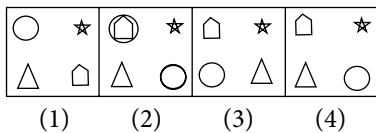
Directions for questions 19 to 25: In each of the following questions, the first two figures are related to each other in a certain way. Find out which figure from the answer figures 1, 2, 3 and 4, should be placed at the ? mark so that the second pair so formed will have a similar relationship and can be placed at "question mark".

19. PROBLEM FIGURES



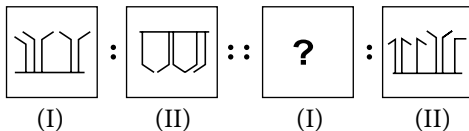
(I) (II) (I) (II)

ANSWER FIGURES



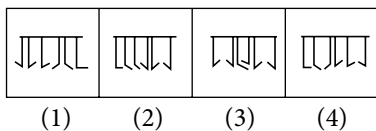
(1) (2) (3) (4)

20. PROBLEM FIGURES



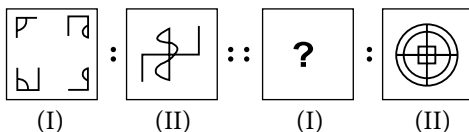
(I) (II) (I) (II)

ANSWER FIGURES



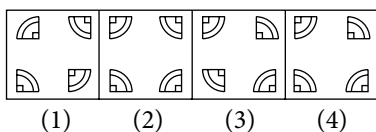
(1) (2) (3) (4)

21. PROBLEM FIGURES



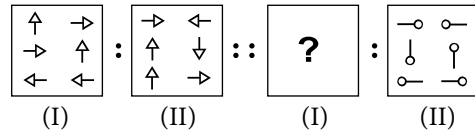
(I) (II) (I) (II)

ANSWER FIGURES



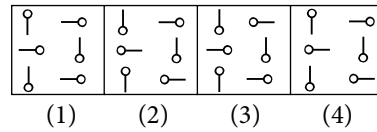
(1) (2) (3) (4)

22. PROBLEM FIGURES



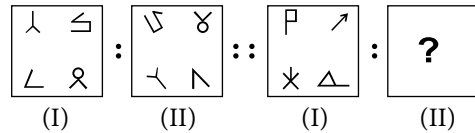
(I) (II) (I) (II)

ANSWER FIGURES



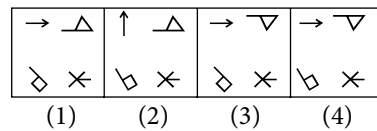
(1) (2) (3) (4)

23. PROBLEM FIGURES



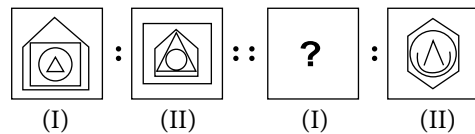
(I) (II) (I) (II)

ANSWER FIGURES



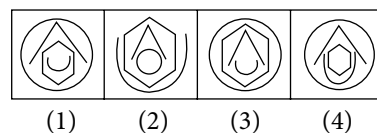
(1) (2) (3) (4)

24. PROBLEM FIGURES



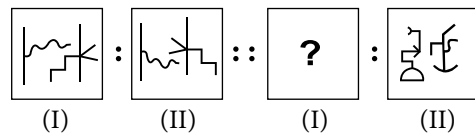
(I) (II) (I) (II)

ANSWER FIGURES



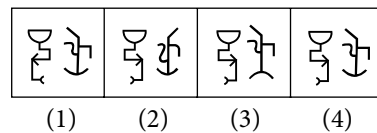
(1) (2) (3) (4)

25. PROBLEM FIGURES



(I) (II) (I) (II)

ANSWER FIGURES

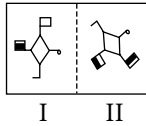


(1) (2) (3) (4)

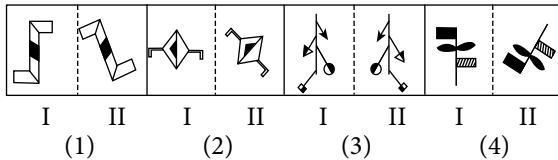
Directions for questions 26 to 30: In each of the following pair of figures given at the left extreme, is followed by four

pair figures. The left figure in the problem figures bears a certain relationship with the right figure. Out of the four pairs given in the answer figures. One should be similar to that pair given in the problem figure. Find that pair out.

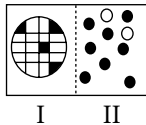
26. PROBLEM FIGURES



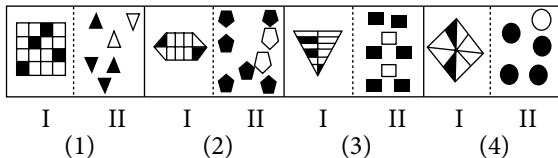
ANSWER FIGURES



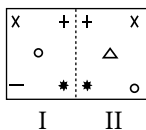
27. PROBLEM FIGURES



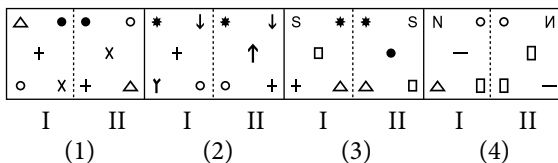
ANSWER FIGURES



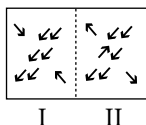
28. PROBLEM FIGURES



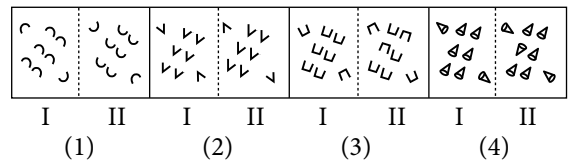
ANSWER FIGURES



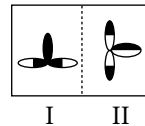
29. PROBLEM FIGURES



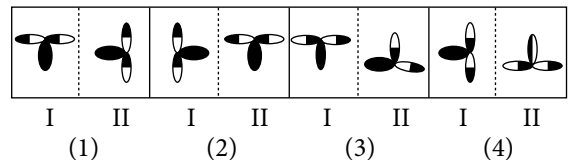
ANSWER FIGURES



30. PROBLEM FIGURES

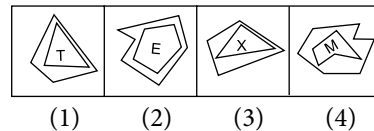


ANSWER FIGURES

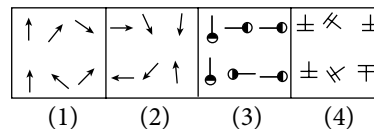


Directions for questions 31 to 35: Among the four given figures, three figures follow the same pattern and one figure is different from these three. Mark this figure (which is different from the other three) as your answer.

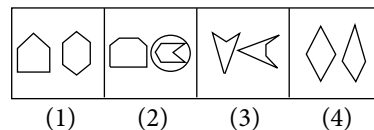
31.



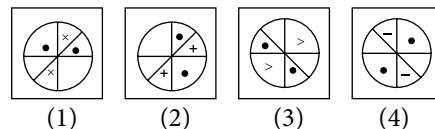
32.



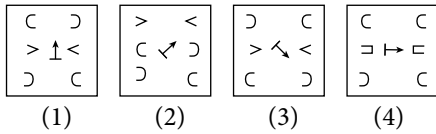
33.



34.

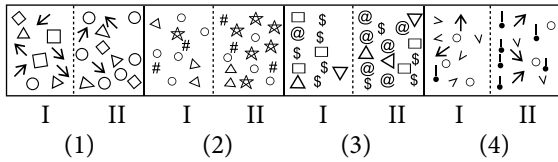


35.

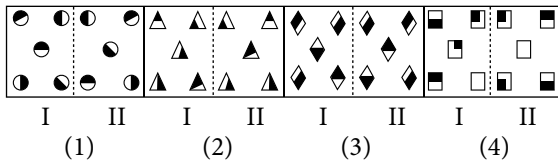


Directions for questions 36 to 40: In each of the following questions, in three out of the four figures element II is related to element I in the same particular pattern. Find out the figure in which the element II is not so related to element I in that pattern.

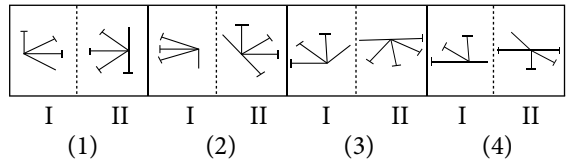
36.



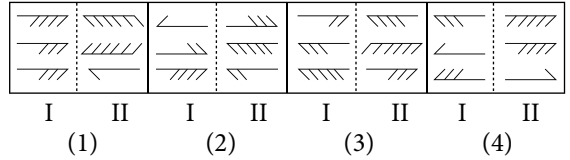
37.



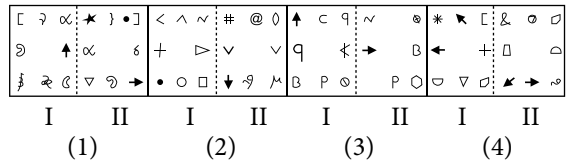
38.



39.



40.



ANSWER KEYS

PRACTICE EXERCISE 7 (A)

1. 4	2. 3	3. 4	4. 1	5. 4	6. 4	7. 3	8. 1	9. 4	10. 4
11. 2	12. 1	13. 4	14. 3	15. 4	16. 2	17. 1	18. 3	19. 1	20. 1
21. 4	22. 4	23. 3	24. 4	25. 1	26. 3	27. 4	28. 3	29. 4	30. 3
31. 1	32. 4	33. 4	34. 2	35. 4	36. 2	37. 1	38. 3	39. 2	40. 4

PRACTICE EXERCISE 7 (B)

1. 3	2. 4	3. 4	4. 2	5. 3	6. 4	7. 3	8. 4	9. 1	10. 4
11. 4	12. 4	13. 4	14. 2	15. 4	16. 3	17. 3	18. 4	19. 4	20. 4
21. 2	22. 4	23. 3	24. 3	25. 4	26. 1	27. 3	28. 3	29. 4	30. 4
31. 4	32. 4	33. 4	34. 4	35. 4	36. 1	37. 4	38. 2	39. 3	40. 2

Paper Cutting and Paper Folding

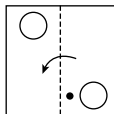
Paper Folding

In paper folding questions, a diagram of a transparent paper is given with certain figures drawn on it. The student

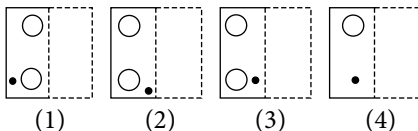
has to identify the figure after the paper is folded in such a way that one part of the figure is super imposed on the remaining part of the figure.

Solved Examples

1. Transparent Sheet

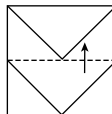


Response Sheet

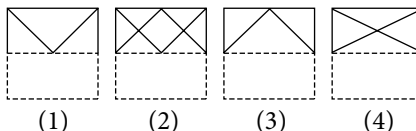


👉 **Solution:** The dotted line in the transparent sheet indicates that the paper is divided into two parts. The arrow on the dotted line shows that the right half of the paper is to be folded onto the second half. Visualizing the combination of the designs on the two parts, we obtain fig (3).

2. Transparent Sheet



Response Sheet



👉 **Solution:** The dotted line in the transparent sheet indicates that the paper is divided into two parts. The arrow on the dotted line shows that the bottom half of the paper is to be folded onto the upper half. Visualizing the combination of the design on the two parts, we obtain fig (2).

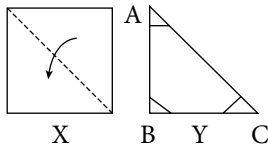
Paper Cutting

In paper cutting questions, a paper is folded several times in a particular manner, which is illustrated in the question.

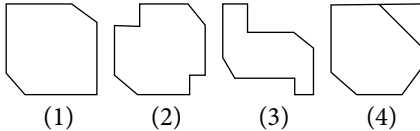
After folding, a hole is made on the folded paper such that all the layers get the hole. The student has to identify the pattern of holes appear on the paper when it is unfolded. Let us study the following worked out examples.

Solved Examples

3. PROBLEM FIGURES



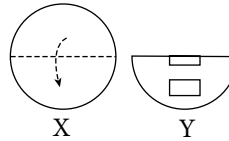
ANSWER FIGURES



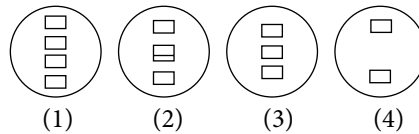
👉 **Solution:** In figure X, the upper half of the square paper sheet is folded onto the lower half. The resultant figure is Y. In figure Y three pieces of triangle shape were punched on the folded paper at the corners of now. Now, if Y is unfolded the same cut will appear at D as it appears at B and at A and C. The cuts will be placed symmetrically

along the diagonals. \therefore The resultant figure is in Choice (2)

4. PROBLEM FIGURES



ANSWER FIGURES



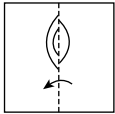
👉 **Solution:** In the figure X, the upper half was folded onto the lower half to become Y. In Y, the folded sheet was punched.

Now, if Y is unfolded then the cuts will be symmetrical to the horizontal diameter. \therefore The resultant figure is Choice (3)

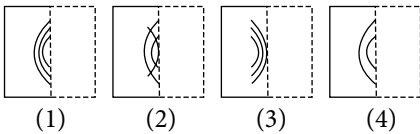
PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 10: In each one of the following problems, a square transparent sheet with a pattern is given. Figure out from amongst the four alternatives as to how the pattern would appear when the transparent sheet is folded along the dotted line as shown by the arrow.

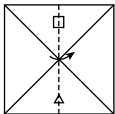
1. Transparent Sheet



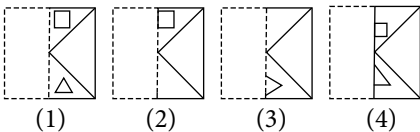
Response Sheet



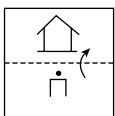
2. Transparent Sheet



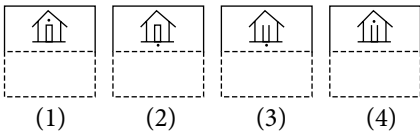
Response Sheet



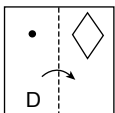
3. Transparent Sheet



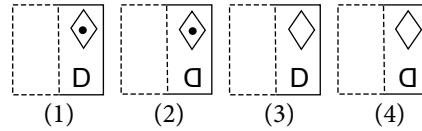
Response Sheet



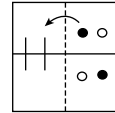
4. Transparent Sheet



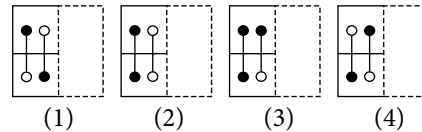
Response Sheet



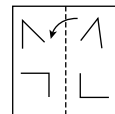
5. Transparent Sheet



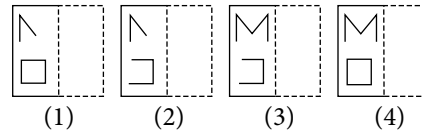
Response Sheet



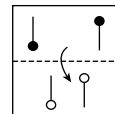
6. Transparent Sheet



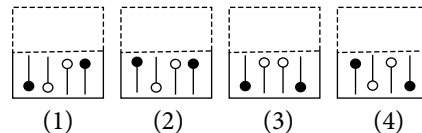
Response Sheet



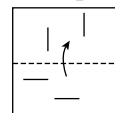
7. Transparent Sheet

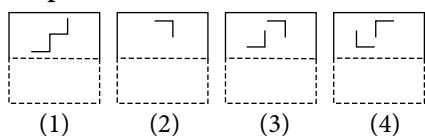
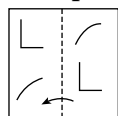
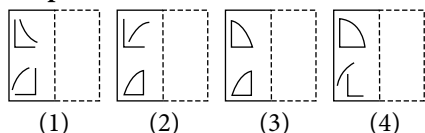
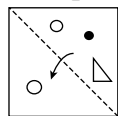
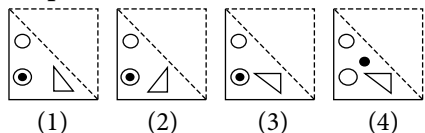


Response Sheet

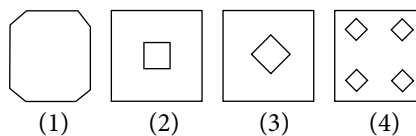
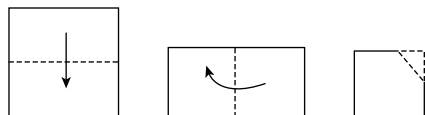
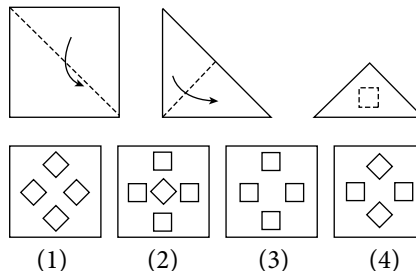
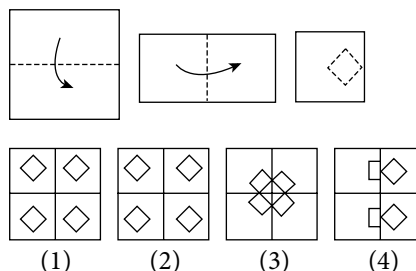
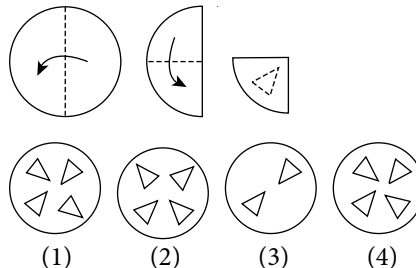
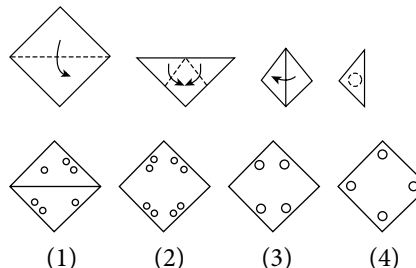


8. Transparent Sheet



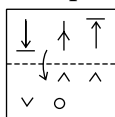
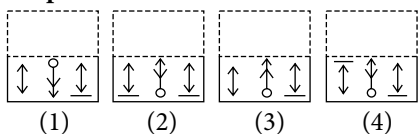
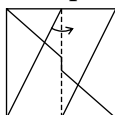
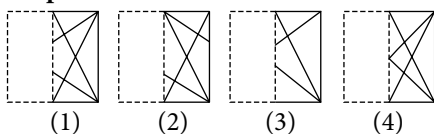
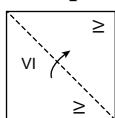
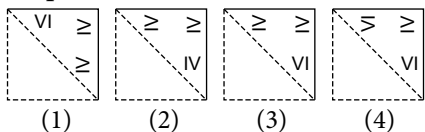
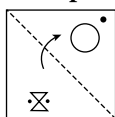
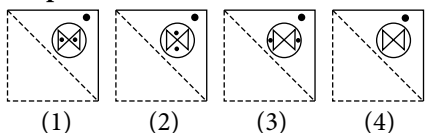
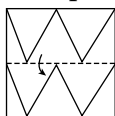
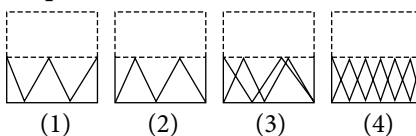
Response Sheet

9. Transparent Sheet

Response Sheet

10. Transparent Sheet

Response Sheet


Directions for questions 11 to 15: The questions that follow contain a set of figures showing a sequence of folding of a piece of paper. The dotted lines in last figure shows the manner in which the folded paper was cut. The figures are followed by five answer figures marked (1), (2), (3) and (4) which you have to choose a figure which would closely resembles the pattern in which the cuttings appear when the paper is unfolded.

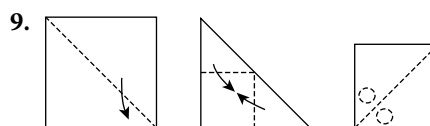
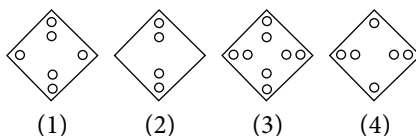
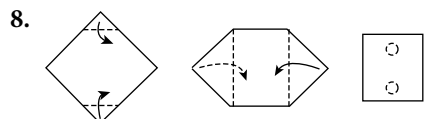
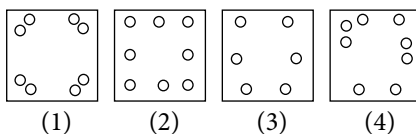
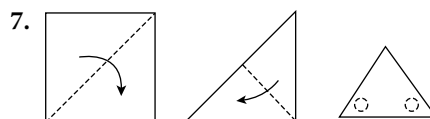
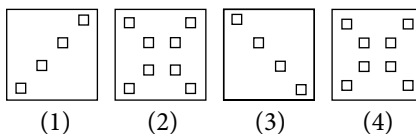
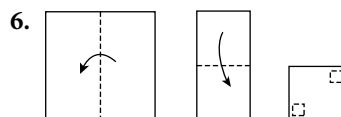
11.

12.

13.

14.

15.

PRACTICE EXERCISE 8 (B)

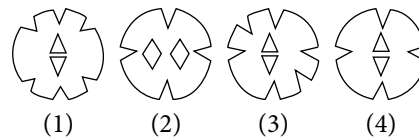
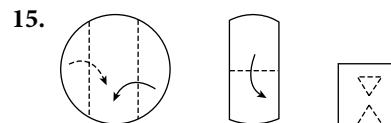
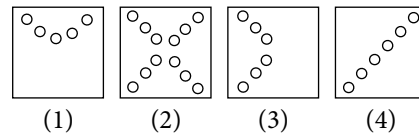
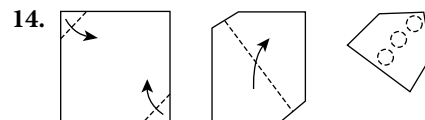
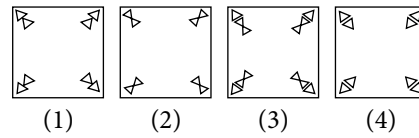
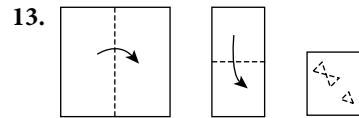
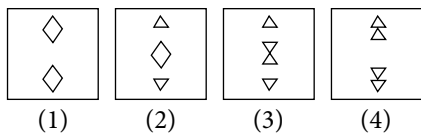
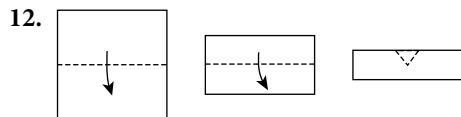
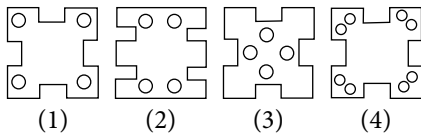
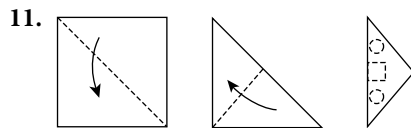
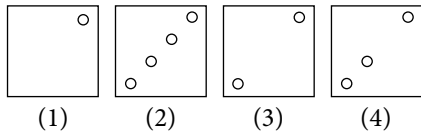
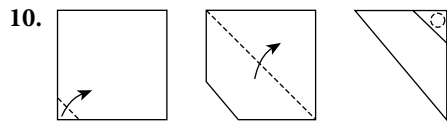
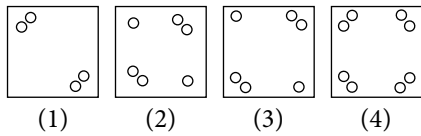
Directions for questions 1 to 5: In each one of the following problems, a square transparent sheet with a pattern is given. Figure out from amongst the four alternatives

as to how the pattern would appear when the transparent sheet is folded along the dotted line as shown by the arrow.

1. Transparent Sheet**Response Sheet****2. Transparent Sheet****Response Sheet****3. Transparent Sheet****Response Sheet****4. Transparent Sheet****Response Sheet****5. Transparent Sheet****Response Sheet**

Directions for questions 6 to 15: The questions that follow contain a set of figures showing a sequence of folding of a piece of paper. The dotted lines in last figure shows the manner in which the folded paper was cut. The figures are followed by five answer figures marked (1), (2), (3) and (4) which you have to choose a figure which would closely resembles the pattern in which the cuttings appear when the paper is unfolded.





ANSWER KEYS

PRACTICE EXERCISE 8 (A)

1. 1 2. 4 3. 3 4. 2 5. 4 6. 2 7. 4 8. 1 9. 3 10. 3
11. 3 12. 3 13. 2 14. 4 15. 2

PRACTICE EXERCISE 8 (B)

1. 4 2. 1 3. 3 4. 2 5. 4 6. 4 7. 1 8. 2 9. 4 10. 1
11. 4 12. 1 13. 3 14. 4 15. 1

Dot Situations

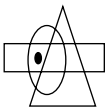
INTRODUCTION

Dot situation is for the assessment and testing of students' shrewd observation power. A problem figure is given in which has one or more dots are placed in the space enclosed

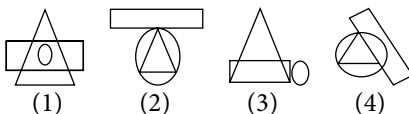
by two or more geometrical figures such as square, rectangle, circle, triangle, pentagon, hexagon, octagon etc. One has to identify the region(s) where the dot is/are situated in the problem figure. Then search for an answer figure in which dots are placed in a similar enclosed area.

Solved Examples

1. PROBLEM FIGURES

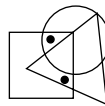


ANSWER FIGURES

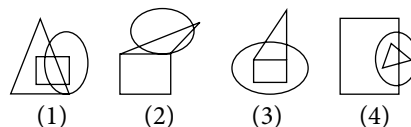


👉 **Solution:** In the problem figure, one dot appears in a region common to both circle and rectangle only. Such a region is present in the answer figure (4).

2. PROBLEM FIGURES

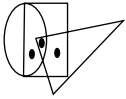


ANSWER FIGURES

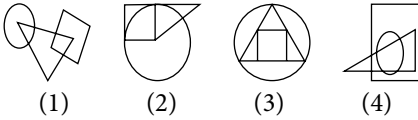


👉 **Solution:** In the problem figure, there are two dots. One dot appears in a region common to both circle and square only and another dot appears in a region common to both triangle and square only. Such a region is present only in the answer figure (1).

3. PROBLEM FIGURES

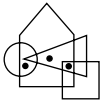


ANSWER FIGURES

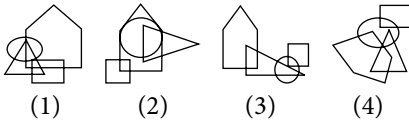


Solution: In the problem figure, there are 3 dots. One dot appears in a region common to all the three figures; another dot appears in a region common to both circle and square only and another dot appears in a region common to both triangle and square only. Such a region is present only in the answer figure (4).

4. PROBLEM FIGURES

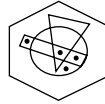


ANSWER FIGURES

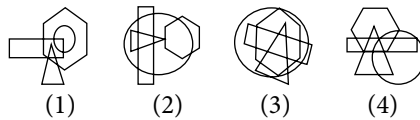


Solution: In the problem figure, there are 3 dots. One dot appears in a region common to both pentagon and circle only, another dot appears in a region common to both pentagon and triangle only and another dot appears in a region common to pentagon, triangle and square. Such a region is present only in the answer figure (1).

5. PROBLEM FIGURES



ANSWER FIGURES

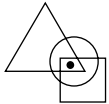


Solution: There are 4 dots in the problem figure. One dot appears in a region common to all the four figures; another dot appears in a region common to hexagon, circle and rectangle only; another dot appears in a region common to hexagon and circle only; another dot appears in a region common to hexagon and rectangle only. Such regions are present only in the answer figure (4).

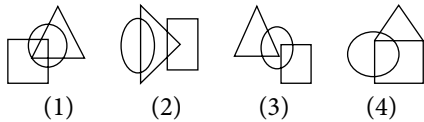
PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 15: In each of the following questions, there is a problem figure, with one or more dots placed in it. This diagram is followed by four answer figures, marked (1), (2), (3), and (4) only one of which is such as to make possible the placement of the dot(s) satisfying the same conditions as in the problem figure. Find such answer figure.

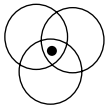
1. PROBLEM FIGURES



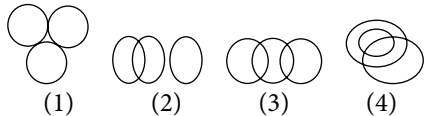
ANSWER FIGURES



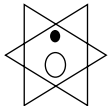
2. PROBLEM FIGURES



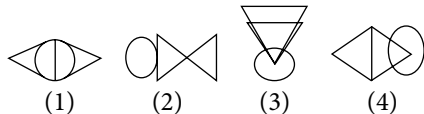
ANSWER FIGURES



3. PROBLEM FIGURES



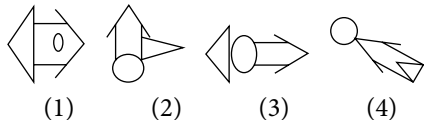
ANSWER FIGURES



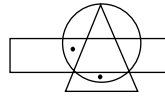
4. PROBLEM FIGURES



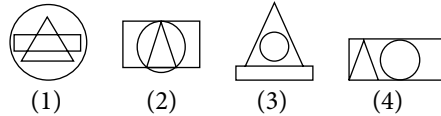
ANSWER FIGURES



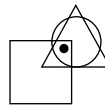
5. PROBLEM FIGURES



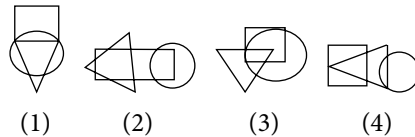
ANSWER FIGURES



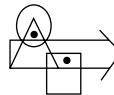
6. PROBLEM FIGURES



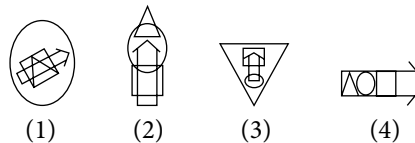
ANSWER FIGURES



7. PROBLEM FIGURES



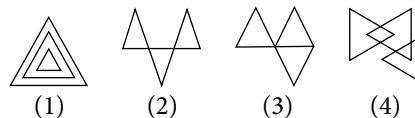
ANSWER FIGURES



8. PROBLEM FIGURES



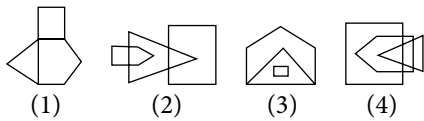
ANSWER FIGURES



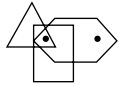
9. PROBLEM FIGURES



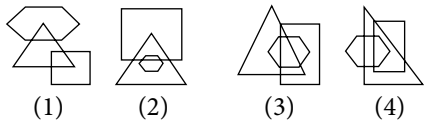
ANSWER FIGURES



10. PROBLEM FIGURES



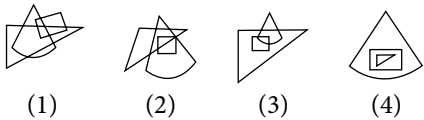
ANSWER FIGURES



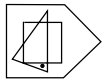
11. PROBLEM FIGURES



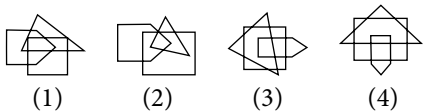
ANSWER FIGURES



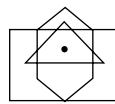
12. PROBLEM FIGURES



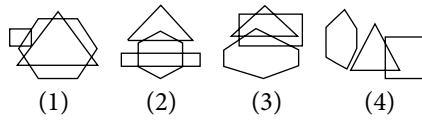
ANSWER FIGURES



13. PROBLEM FIGURES



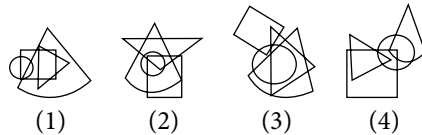
ANSWER FIGURES



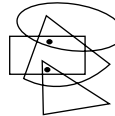
14. PROBLEM FIGURES



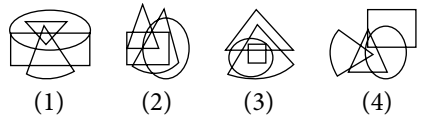
ANSWER FIGURES



15. PROBLEM FIGURES



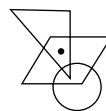
ANSWER FIGURES



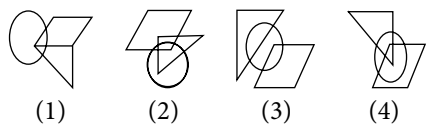
PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 15: In each of the following questions, there is a problem figure, with one or more dots placed in it. This diagram is followed by four answer figures, marked (1), (2), (3) and (4) only one of which is such as to make possible the placement of the dot(s) satisfying the same conditions as in the problem figure. Find such answer figure.

1. PROBLEM FIGURES



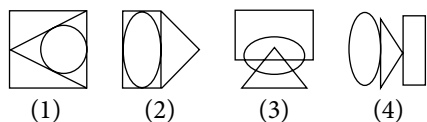
ANSWER FIGURES



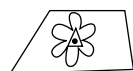
2. PROBLEM FIGURES



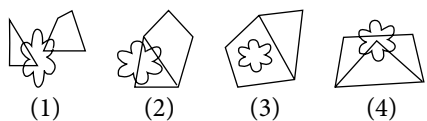
ANSWER FIGURES



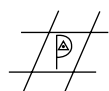
3. PROBLEM FIGURES



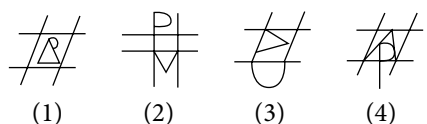
ANSWER FIGURES



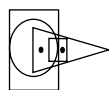
4. PROBLEM FIGURES



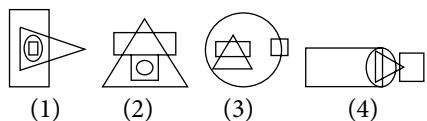
ANSWER FIGURES



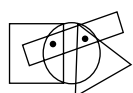
5. PROBLEM FIGURES



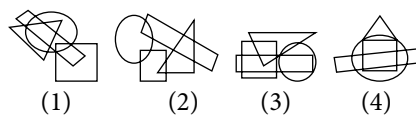
ANSWER FIGURES



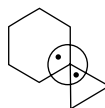
6. PROBLEM FIGURES



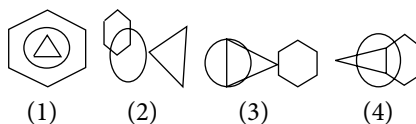
ANSWER FIGURES



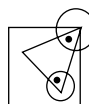
7. PROBLEM FIGURES



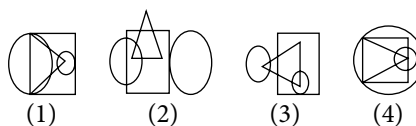
ANSWER FIGURES



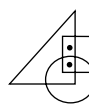
8. PROBLEM FIGURES



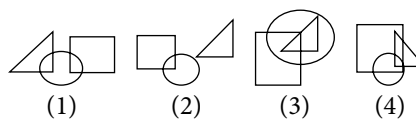
ANSWER FIGURES



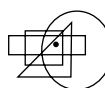
9. PROBLEM FIGURES



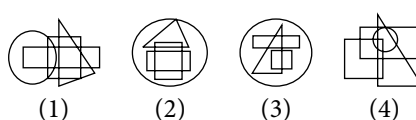
ANSWER FIGURES



10. PROBLEM FIGURES



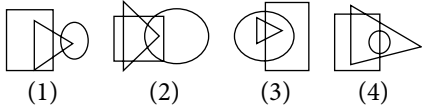
ANSWER FIGURES



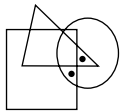
11. PROBLEM FIGURES



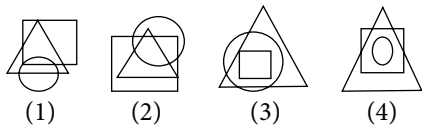
ANSWER FIGURES



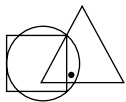
12. PROBLEM FIGURES



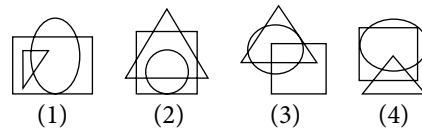
ANSWER FIGURES



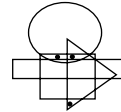
13. PROBLEM FIGURES



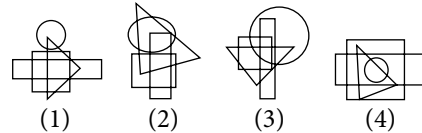
ANSWER FIGURES



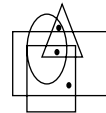
14. PROBLEM FIGURES



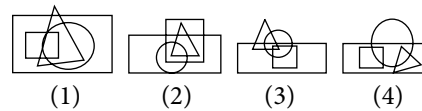
ANSWER FIGURES



15. PROBLEM FIGURES



ANSWER FIGURES



ANSWER KEYS

PRACTICE EXERCISE 9 (A)

1. 1	2. 4	3. 3	4. 4	5. 1	6. 3	7. 2	8. 4	9. 2	10. 4
11. 1	12. 1	13. 3	14. 1	15. 4					

PRACTICE EXERCISE 9 (B)

1. 2	2. 1	3. 4	4. 4	5. 4	6. 1	7. 4	8. 1	9. 4	10. 4
11. 2	12. 2	13. 3	14. 3	15. 3					

Embedded Figures

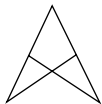
INTRODUCTION

Directions for questions 1 and 2: These type of questions are designed to check the keen observation of the student.

The questions are of this type, a problem figure is given (X) followed by five figures (1), (2), (3), and (4). The answer figure has a hidden figure of the problem figure and one should identify that figure.

Solved Examples

1.



(X)



(1)



(2)



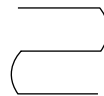
(3)



(4)

👉 **Solution:**
Choice (1)

2.



(X)



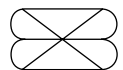
(1)



(2)



(3)



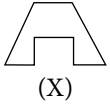
(4)

👉 **Solution:**
Choice (4)

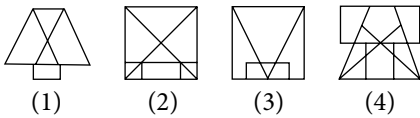
PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 15: In each question below, you are given a figure (X) followed by five figures (1), (2), (3) and (4) such that (X) is embedded in one of them. Trace out the correct alternative.

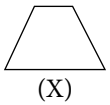
1. PROBLEM FIGURES



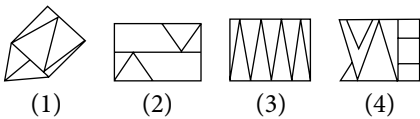
ANSWER FIGURES



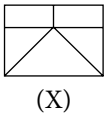
2. PROBLEM FIGURES



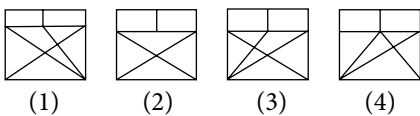
ANSWER FIGURES



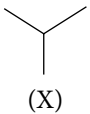
3. PROBLEM FIGURES



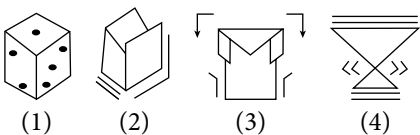
ANSWER FIGURES



4. PROBLEM FIGURES



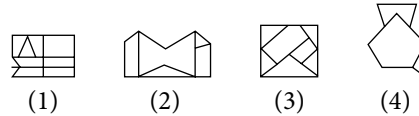
ANSWER FIGURES



5. PROBLEM FIGURES



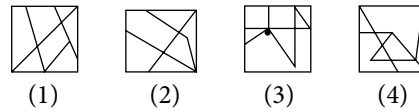
ANSWER FIGURES



6. PROBLEM FIGURES



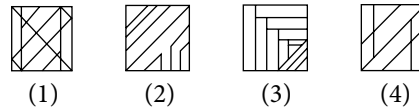
ANSWER FIGURES



7. PROBLEM FIGURES



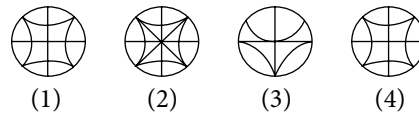
ANSWER FIGURES



8. PROBLEM FIGURES



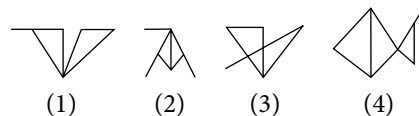
ANSWER FIGURES



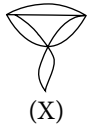
9. PROBLEM FIGURES



ANSWER FIGURES

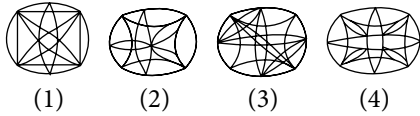


10. PROBLEM FIGURES



(X)

ANSWER FIGURES



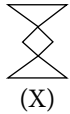
(1)

(2)

(3)

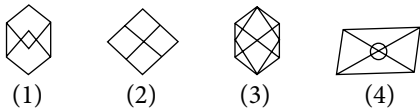
(4)

11. PROBLEM FIGURES



(X)

ANSWER FIGURES



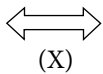
(1)

(2)

(3)

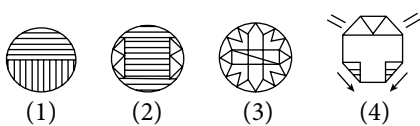
(4)

12. PROBLEM FIGURES



(X)

ANSWER FIGURES



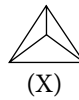
(1)

(2)

(3)

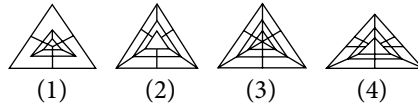
(4)

13. PROBLEM FIGURES



(X)

ANSWER FIGURES



(1)

(2)

(3)

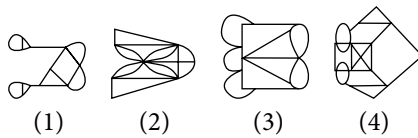
(4)

14. PROBLEM FIGURES



(X)

ANSWER FIGURES



(1)

(2)

(3)

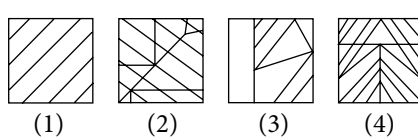
(4)

15. PROBLEM FIGURES



(X)

ANSWER FIGURES



(1)

(2)

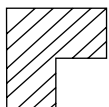
(3)

(4)

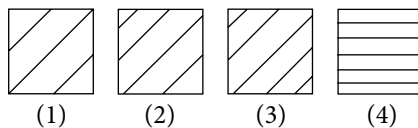
PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 15: In each of the following questions, a portion from the problem figure is missing. Complete that missing portion by selecting from the given answer figures (1), (2), (3) and (4).

1. PROBLEM FIGURES



ANSWER FIGURES



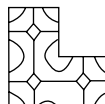
(1)

(2)

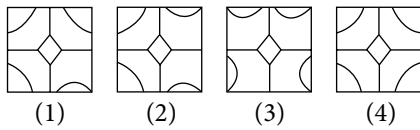
(3)

(4)

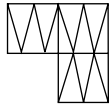
2. PROBLEM FIGURES



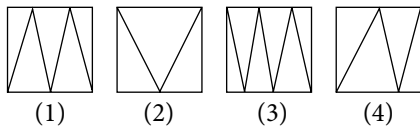
ANSWER FIGURES



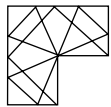
3. PROBLEM FIGURES



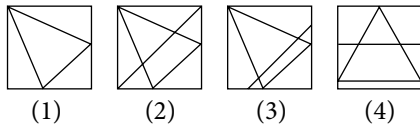
ANSWER FIGURES



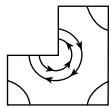
4. PROBLEM FIGURES



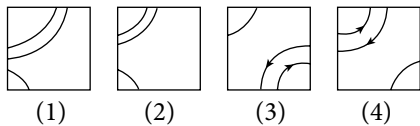
ANSWER FIGURES



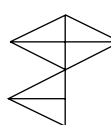
5. PROBLEM FIGURES



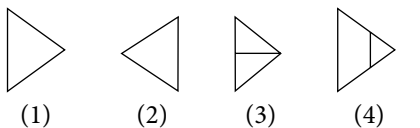
ANSWER FIGURES



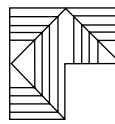
6. PROBLEM FIGURES



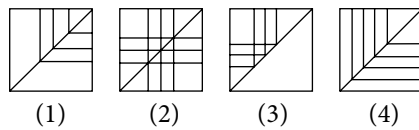
ANSWER FIGURES



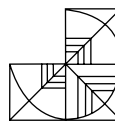
7. PROBLEM FIGURES



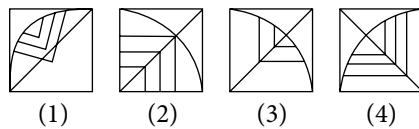
ANSWER FIGURES



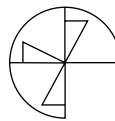
8. PROBLEM FIGURES



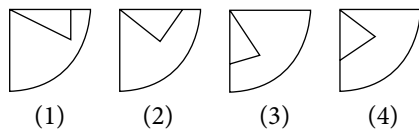
ANSWER FIGURES



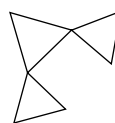
9. PROBLEM FIGURES



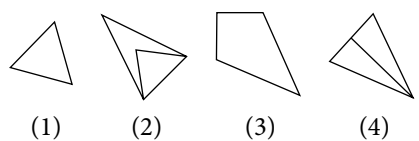
ANSWER FIGURES



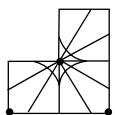
10. PROBLEM FIGURES



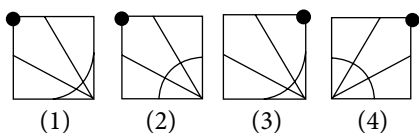
ANSWER FIGURES



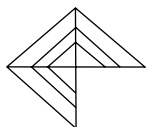
11. PROBLEM FIGURES



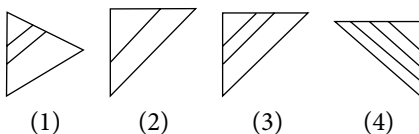
ANSWER FIGURES



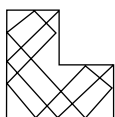
12. PROBLEM FIGURES



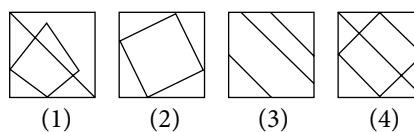
ANSWER FIGURES



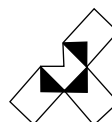
13. PROBLEM FIGURES



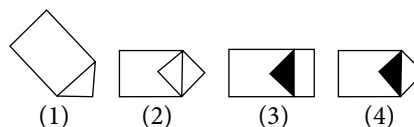
ANSWER FIGURES



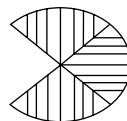
14. PROBLEM FIGURES



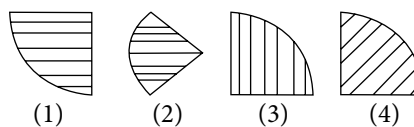
ANSWER FIGURES



15. PROBLEM FIGURES



ANSWER FIGURES



ANSWER KEYS

PRACTICE EXERCISE 10 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 4 | 2. 3 | 3. 4 | 4. 1 | 5. 2 | 6. 4 | 7. 4 | 8. 2 | 9. 1 | 10. 2 |
| 11. 1 | 12. 2 | 13. 3 | 14. 3 | 15. 4 | | | | | |

PRACTICE EXERCISE 10 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 3 | 2. 4 | 3. 1 | 4. 2 | 5. 4 | 6. 3 | 7. 4 | 8. 4 | 9. 1 | 10. 1 |
| 11. 1 | 12. 3 | 13. 4 | 14. 4 | 15. 2 | | | | | |

Analytical Puzzles

LINEAR SEQUENCING

Linear sequencing is essentially arranging the items in a sequence (in a single line). The questions of this type are also referred to as “Seating Arrangement”. The word “seating arrangement” should not be misconstrued—it should

not be treated as questions involving only persons sitting as per specified conditions. Essentially, these questions involve arranging subjects (people or things) according to the given conditions. The arrangement is done only on one “axis” and, hence, the position of the subjects assumes importance here in terms of order like first position, second position, etc. Let us look at the examples:

Solved Examples

Directions for questions 1 to 3: Read the data given below carefully and answer the questions that follow.

Seven persons Paul, Queen, Rax, Sam, Tom, Unif and Vali are sitting in a row facing us. Rax and Sam sit next to each other. There must be exactly four persons between Queen and Vali. Sam sits to the immediate right of Queen.

1. If Queen is not sitting at either extreme of the row, then who among the following has as many persons on his left as on his right?
(1) Sam (2) Unif
(3) Rax (4) Vali
2. If Queen sits at one extreme, then who is at the other extreme?

- (1) Paul
- (2) Tom
- (3) Vali
- (4) Cannot be determined

3. In how many different ways can the seven persons sit in a row?
(1) 3 (2) 2
(3) 10 (4) 12

👉 Solutions for questions 1 to 3:

Let us write down the conditions given in short form and then represent them pictorially. Also, let us treat the left of the persons sitting as “left” and their right as “right” for interpreting the conditions.

Rax and Sam sit next to each other → RS or SR.

There are exactly 4 persons between Queen and Vali → Q ——— V or V ——— Q.

Sam sits to the immediate right of Queen → SQ.

Now let us analyse the data/conditions that we are given and then put the three conditions together. Let us number the seats from *our* left to right as Seat 1 to Seat 7.

Since S is to the right of Q and since R and S have to be next to each other, R can come only to the immediate right of S. Thus, R, S and Q, will be in the order RSQ. Since there are four persons between Q and V, Q can be placed in seats 1, 2, 6 or 7. But if Q is in seat 1 or 2, then there are no seats for R and S. Hence, there are only two seats available for Q. Let us fix the positions of R, S and V in each of these two positions of Q and write them down. The directions Left and Right are as shown below.

◀ R ▶ L

Arrangement I:

1	2	3	4	5	6	7
	V			R	S	Q

Arrangement II:

1	2	3	4	5	6	7
V			R	S	Q	

These are the only two arrangements possible for the four persons V, R, S and Q. The other three persons Paul, Tom and Unif can sit in the three vacant seats in any order, as no information is given about them. Now let us look at each of the questions.

1. If Queen is not at the extreme right, then only arrangement II mentioned above is possible. The person who has as many persons on his left as on his right can only be the person who is sitting in the middle seat, i.e. seat 4. In this arrangement, Rax is sitting in seat 4.

Choice (3)

2. “Queen sits at one extreme” means that we should look at arrangement I. In this arrangement, any one out of the three persons Paul, Tom and Unif can be in seat 1, i.e., extreme right.

Choice (4)

3. We have two possible arrangements—“Arrangement I and Arrangement II” that we have already looked at. In each arrangement, the remaining three people can sit in the remaining three seats in 6 ways. Thus, a total of 12 ways of seating the seven persons is possible.

Choice (4)

Circular Arrangement

Questions on circular arrangement involve seating of people around a table or arrangement of things in a circular manner (for example, different coloured beads strung to form a necklace). In case of people sitting around a table, the table could be of any shape – rectangular, square, circular or any other.

The data given in such sets of questions specify the positions of some or all of the individuals (or things) in the arrangement. The positions are specified through conditions involving specified persons sitting (or not sitting) opposite each other or a particular person sitting to the right or left of another person, etc.

Solved Examples

Directions for questions 4 to 6: Read the following information and answer the questions that follow.

P, Q, R, S and T sit around a table. P sits two seats to the left of R and Q sits two seats to the right of R.

4. If S sits in between Q and R, who sits to the immediate right of P?

- | | |
|-------|-------|
| (1) T | (2) S |
| (3) Q | (4) R |

5. Which of the following cannot be the correct seating arrangement of the five persons in either the clockwise direction or the anti-clockwise direction?

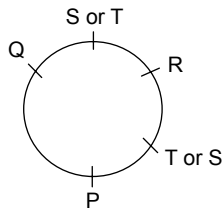
- (1) P, Q, R, S, T (2) P, S, R, T, Q
 (3) P, Q, S, R, T (4) P, T, R, S, Q

6. If a new person U joins the group such that the initial conditions for the seating arrangement should be observed and also a new condition that U does not sit next to P, S or T be satisfied, then who will be the neighbours of P (one on either side)?

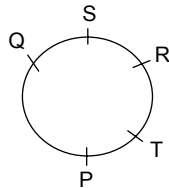
- (1) S and T (2) S and Q
 (3) T and R (4) R and Q

☞ **Solutions for questions 4 to 6:**

P sits two seats to the left of R, and Q sits two seats to the right of R. We can represent this information in the diagram below.



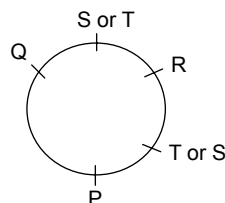
4. If S sits between Q and R, then the arrangement is as follows.



As can be seen from the diagram, T is to the immediate right of P.

Choice (1)

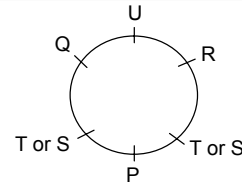
5. We will take each choice and see whether it fits in the arrangement that we represented through a diagram in the analysis of the data (the same diagram is reproduced below).



We can see that the arrangement given in choice (1) is not possible and hence the answer choice is (1).

Choice (1)

6. We create a new slot for the sixth person. But since U will not sit next to P, S or T, he will have to sit between R and Q. The arrangement will then look as follows:



As we can see from the diagram, the neighbours of P will be T and S.

In addition to the questions that we have seen above, where a set of questions are based on the data given, there are also “stand-alone” questions. Given below are examples of this type.

7. Four persons A, B, C and D arrive to attend a meeting. D arrives 10 minutes after B and twenty minutes before A, who arrives 10 minutes before C. Who is the first person to arrive at the meeting?
- (1) A (2) B
 (3) C (4) D

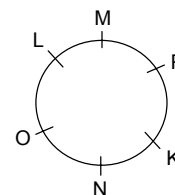
☞ **Solution:** C arrived after A. A arrived after D. D arrived after B. This implies that B arrived first.

Choice (2)

8. Six persons K, L, M, N, O and P are sitting around a table. K and L do not sit next to each other. O and P are opposite each other. M is sitting to the immediate right of P. If K is not between O and M, then N is not next to P. Which of the following is not an arrangement (in clockwise direction) satisfying the conditions given above?

- (1) NKOLM P (2) PKNOLM
 (3) LNOKMP (4) KMPNLO

☞ **Solution:** O and P are opposite to each other. M is to the right of P. Then we have two possible arrangements. In one case, when K is between O and M, the other two slots can be occupied by N and L - we cannot uniquely determine the slots of L and N. In the second case, if K is not between O and M (then, L has to be between O and M), then N is not next to P. This means that K has to be next to P and the only slot left is for N which is to the right of O.



From the choices, we can clearly see that choice (1) is the correct answer because that arrangement is not possible.

Choice (1)

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 5: These questions are based on the following information.

Eight boys A, B, C, D, E, F, G and H are seated around a circular table. A and B are opposite to each other. F is neither next to H nor next to G. H is to the immediate left of B and opposite G. D is to the immediate right of B.

1. Who is to the right of A?

(1) G	(2) F
(3) C	(4) E
2. Who is two places to the right of B?

(1) C	(2) D
(3) E	(4) Cannot be determined
3. If F and G interchange places then who is opposite to H?

(1) C	(2) D
(3) G	(4) F
4. If C is to the immediate right of F, then who is to the immediate left of G?

(1) A	(2) C
(3) E	(4) Cannot be determined
5. Who is opposite to D?

(1) E	(2) G
(3) H	(4) F

Directions for questions 6 to 10: These questions are based on the following information.

Four girls—A, B, C and D and four boys—E, F, G and H are sitting around an octagonal table. No two boys can sit adjacent to each other. Also, it is known that A sits to the right of E and opposite to D. F sits to the left of B. G sits to the left of C, but not next to D.

6. B is sitting between _____.

(1) F and G	(2) E and F
(3) H and F	(4) G and D
7. Who sits to the right of H?

(1) D	(2) C
(3) B	(4) A

8. If A interchanges his place with the person who is sitting opposite to C, then who sits to the right of F?

(1) E	(2) B
(3) A	(4) G

9. If every boy interchanges his position with the person sitting opposite to him, then who sits between C and D?

(1) E	(2) F
(3) G	(4) H

10. Who sits between B and A?

(1) E	(2) F
(3) G	(4) H

Directions for questions 11 and 12: These questions are based on the following information.

Five buses B_1, B_2, B_3, B_4 and B_5 operate between two stations S_1 and S_2 . The 1st bus, which leaves from S_1 , is the 3rd bus to reach S_2 . B_1 , the 2nd bus to reach S_2 , reaches after B_5 . B_4 , the 2nd bus to leave the station S_1 is the last to reach S_2 , immediately after B_2 , which leaves S_1 after B_5 and B_1 respectively.

11. Which bus is the first bus to leave from the S_1 ?

(1) B_4	(2) B_5
(3) B_3	(4) B_2
12. What is the position of B_1 in leaving S_1 and in reaching S_2 ?

(1) 4th, 3rd	(2) 3rd, 5th
(3) 3rd, 2nd	(4) 4th, 2nd

Directions for questions 13 to 18: Select the correct alternative from the given choices.

13. A train starts from station S_1 to S_6 and travels through the intermediary stations S_2, S_3, S_4 and S_5 respectively. The train takes 30 minutes to travel from one station to the next station and it stops at every station for 10 minutes. If the train reaches S_5 at 8:30 a.m., then at what time did the train start at S_1 ?

(1) 6:00 a.m.	(2) 6:10 a.m.
(3) 6:20 a.m.	(4) 6:30 a.m.
14. There are six stations S_1, S_2, S_3, S_4, S_5 and S_6 . A train t_1 starts from S_1 to S_6 and another train t_2 starts from S_6 to S_1 . These trains take 30 minutes to travel from one station to the next station and at every station

they stop for 10 minutes. If t_1 reaches S_4 at 8:20 a.m. and t_2 reaches S_3 at 9:00 a.m. then at what time did the trains t_1 and t_2 start at stations S_1 and S_6 respectively?

- (1) 6:30 a.m., 7:00 a.m. (2) 6:00 a.m., 6:30 a.m.
(3) 6:30 a.m., 7:10 a.m. (4) 6:10 a.m., 6:30 a.m.

15. In the above problem, at which station will the two trains meet each other?

- (1) S_4
(2) S_2
(3) S_3
(4) Cannot be determined

16. Five students A, B, C, D and E participated in a 100 m race and finished the race in five different timings (not necessarily in the same order). Three students finished the race behind D and three students finished the race ahead of E. C is neither the first nor the last student to finish the race. If A finishes the race after B, then who is the last student to finish the race?

- (1) D (2) E
(3) B (4) A

17. Six buses B_1, B_2, B_3, B_4, B_5 and B_6 leave a bus station at six different timings (not necessarily in the same order). Buses B_2, B_3 and B_5 leave the station one after the other in the same order. B_3 is neither the 2nd nor the 5th bus to leave the station. B_4 is neither the 1st nor the 6th bus to leave the station. If B_1 leaves the station after B_6 , then in which position will B_4 leave the station?

- (1) 4th
(2) 5th
(3) 2nd
(4) Cannot be determined

18. In the above problem, if B_1 leaves the station immediately after B_5 , then in which position will B_3 leave the station?

- (1) 3rd (2) 4th
(3) 5th (4) 3rd or 4th

Directions for questions 19 and 20: These questions are based on the following information.

T_1, T_2 and T_3 are three trains that leave station S_1 and reach station S_2 . The train number and the order in which they depart or arrive is not the same. The first train to leave S_1 is the third train to reach S_2 .

19. Which train is the first to leave from S_1 ?

- (1) T_1 (2) T_2
(3) T_3 (4) T_2 or T_3

20. Which train is the second to reach S_2 ?

- (1) T_1 (2) T_2
(3) T_3 (4) T_2 or T_3

Directions for questions 21 to 25: These questions are based on the following questions.

Each one of the five persons A, B, C, D and E is lives in a different house which are along one side of a street. Each of these houses is painted with a different colour among Red, Pink, Blue, Green and White.

- (a) The house which painted in Red colour is on the right hand side of the house in which A lives, which is painted with Blue.
(b) Neither D nor E is living in the houses which are at any end of the row.
(c) C is living in the house which is to the immediately left house in which E is living.
(d) Neither B nor D is living in Red colour house.
(e) Either E or D is in Green colour house which is to the immediate left of the Red colour house.
(f) Neither of the extreme houses are painted with White.

21. What is the colour of the house in which B lives?

- (1) Pink (2) White
(3) Red (4) Green

22. What is the colour of the house which is to the immediate left of the Pink coloured house?

- (1) White (2) Red
(3) Green (4) Blue

23. Who stays in the extreme left end house?

- (1) C (2) D
(3) B (4) A

24. What is the colour of the house which is at the middle of the row?

- (1) White (2) Red
(3) Green (4) (1) or (2)

25. How many houses are there to the right of D's house?

- (1) 1 (2) 2
(3) 3 (4) 4

Directions for questions 26 to 28: These questions are based on the following data.

A committee of four members is to be sent to the World Science Conference. One experimental scientist and one theoretical scientist from each of the four subjects Quantum Mechanics, Electronics, Organic Chemistry and Inorganic Chemistry are identified, and from

these a committee of four is to be selected. Prayag and Krishna are the scientists in Quantum Mechanics. Shakuntala and Alexander are the scientists in Electronics. Ranganathan and Tambaran are the scientists in Organic Chemistry. Dhananjay and Vaman are the scientists in Inorganic Chemistry.

- (i) The committee should consist of two theoretical scientists and two experimental scientists.
- (ii) The committee should consist of scientists from at least three subjects.
- (iii) Prayag and the experimental scientist from Inorganic Chemistry are to be selected.
- (iv) Not more than one scientist is to be selected from Electronics and exactly one out of Ranganathan and the theoretical scientist of Quantum Mechanics is to be selected.
- (v) Exactly one out of Shakuntala, the theoretical scientist, and Tambaran is to be selected.

26. If Ranganathan is selected, then which of the following is false?

- (1) No one is selected from Electronics.
- (2) Ranganathan is a theoretical scientist.
- (3) Prayag is an experimental scientist.
- (4) None of the above

27. If no one is selected from the electronics, then which of the following is true?

- (1) The two scientists Quantum Mechanics are selected.

- (2) Only one Organic Chemistry Scientist is selected.
- (3) Tambaran is the experimental scientist.
- (4) None of these

28. Which of the following is a possible team?

- (1) Prayag, Dhananjay, Tambaram, Alexander
- (2) Ranganathan, Prayag, Krishna, Dhananjay.
- (3) Vaman, Alexander, Krishna, Prayag
- (4) Dhananjay, Vaman, Shakuntala, Ranganathan

Directions for questions 29 and 30: These questions are based on the following information.

A round table conference is attended by six persons—A through F—each of whom is from a different country among—Australia, Bangladesh, China, Denmark, England and France. Further,

- (i) F, who is from Bangladesh, is sitting to the right of B.
- (ii) The person from France is sitting opposite C, who is from Australia.
- (iii) D is adjacent to A and B.
- (iv) A is from China and E is from Denmark.

29. If C is sitting to the left of A, who is from France?

- (1) F
- (2) B
- (3) D
- (4) E

30. If E is sitting to the right of C, who is from England?

- (1) A
- (2) D
- (3) B
- (4) F

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 5: These questions are based on the following information.

Six friends—A, B, C, D, E and F are sitting around a circular table as per the following conditions. F is sitting to the left of A. B is sitting between C and E and is opposite to A. E is sitting to the right of D.

1. Who is sitting opposite to D?

- (1) A
- (2) B
- (3) C
- (4) F

2. Who is sitting to the left of B?

- (1) C
- (2) E
- (3) D
- (4) F

3. If E interchanges his place with the person sitting opposite to B, then who sits to the right of F?

- (1) A
- (2) C
- (3) B
- (4) E

4. If each person interchanges his place with the person opposite, then who is sitting to the right of C?

- (1) E
- (2) B
- (3) A
- (4) F

5. If A interchanges his place with D, F interchanges with E, and B interchanges with C, then which of the following statements must be true?

- (1) A is to the right of F.
- (2) There are two persons sitting between B and D.

- (3) C and D sit opposite each other.
 (4) E sits to the right of F.

Directions for questions 6 to 12: Select the correct alternative from the given choices.

6. Six persons—P, Q, R, S, T and U are sitting around a hexagonal table. P is opposite to U and T is not sitting next to R and S. Q is sitting to the immediate right of U and opposite to R. Who is sitting to the immediate left of P?
 (1) R (2) S
 (3) T (4) U
7. Eight persons—A, B, C, D, E, F, G and H are sitting around a circular table. A is sitting opposite to B, C is sitting opposite to D, H is sitting adjacent to B and D and G is sitting to the right of A. If E is sitting to the right of D, then which of the following statements must be true?
 (1) D is sitting between E and G.
 (2) E is sitting adjacent to F.
 (3) F is sitting between B and C.
 (4) Either E or F is sitting opposite to H.
8. Seven persons—A, B, C, D, E, F and G are sitting around a circular table in the following manner. C is sitting between E and F. G is sitting to the left of A, who is sitting to the left of D. If F is sitting to the left of G, then who is sitting to the right of B?
 (1) F (2) C
 (3) D (4) E
9. Each of six boys P through U is of different height. T is shorter than P. U is shorter than Q who is taller than S. S is taller than P but shorter than R. Who is the shortest?
 (1) U
 (2) S
 (3) T
 (4) Cannot be determined
10. A, B, C and D are four friends each of whom wear a shirt of different colour among—Red, White, Green and Yellow. C wear neither Red nor White shirt. B wear either Yellow or Red shirt. If D wears Green shirt, then what is the colour of A's shirt?
 (1) White (2) Yellow
 (3) Red (4) (1) or (2)
11. 10 students enter into the class after A and 15 students enter into the class before B. 5 students enter

into the class in between A and B. How many students are there in the class?

- (1) 32
 (2) 16
 (3) 20
 (4) Cannot be determined

12. In the above problem, if A enters into the class before B, then how many students are there in the class?

- (1) 20 (2) 32
 (3) 25 (4) 16

Directions for questions 13 to 17: These questions are based on the following information.

Eight persons of different heights are stood in a queue. Only one person is ahead of the eighth tallest person. Number of persons ahead of the second tallest is same as the number of persons behind the second shortest person. The fifth tallest person stood immediately ahead of the second tallest. The eighth tallest person is immediately behind the tallest person. The third tallest person is exactly in between the fourth and the sixth tallest persons.

13. How many persons are ahead of the fifth tallest person?
 (1) 3 (2) 2
 (3) 4 (4) 5
14. What is the position of the 'fourth tallest person'?
 (1) Four positions behind the second tallest person.
 (2) Two positions behind the sixth tallest person.
 (3) One position ahead of the seventh tallest person.
 (4) Cannot be determined
15. Who is immediately ahead of the fourth tallest person?
 (1) The second tallest person.
 (2) The third tallest person.
 (3) The seventh tallest person.
 (4) Cannot be determined
16. How many people stood behind the second tallest person?
 (1) 2 (2) 3
 (3) 4 (4) 5
17. How many persons stood in between the third tallest and second shortest persons?
 (1) 1 (2) 2
 (3) 3 (4) 4

Directions for questions 18 to 20: These questions are based on the following information.

Each of eight persons A through H likes a different colour among—Red, Blue, Black, White, Pink, Orange, Yellow and Indigo. The information known is

- (a) A likes neither Red nor Indigo.
- (b) Either B or C likes Yellow.
- (c) E likes either Pink or Indigo.
- (d) Either G or H likes White.
- (e) B likes Black while D does not like Blue.
- (f) F and G like Pink and Blue in any order.

18. Who likes Red colour?

- (1) B (2) C
- (3) D (4) H

19. Which of the following must be true?

- (1) B likes Yellow (2) F likes Pink
- (3) A likes Orange (4) G likes Pink

20. What are the colours that A and E like?

- (1) Red, Indigo (2) Red, Pink
- (3) Black, Indigo (4) Orange, Indigo

Directions for questions 21 to 25: These questions are based on the following information.

Each of the seven cities—Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Bhubaneshwar and Bhopal is given a different rank among—1 through 7. Each city has a different Mayor among the seven Mayors A through G. It is known that,

- (i) A is not the mayor of either Hyderabad or Chennai.
- (ii) Bhopal is ranked 6 and G is its Mayor. Chennai is ranked 4. Hyderabad is not ranked 5.
- (iii) F is the Mayor of the city which is ranked 7. Mumbai is ranked 2.
- (iv) D and B are the Mayors of the cities which are ranked 5 and 3 respectively.
- (v) Bangalore or the city to which D is the Mayor is ranked 3. D is not the Mayor of Bhubaneshwar.
- (vi) E is the Mayor of either Mumbai or the city which is ranked 3.

21. Who is the Mayor of Mumbai?

- (1) A (2) C
- (3) E (4) B

22. To which city is D the Mayor?

- (1) Kolkata (2) Hyderabad
- (3) Bangalore (4) Bhubaneshwar

23. Which of the following is a correct combination?

- (1) Bangalore – Rank 3
- (2) Chennai – Mayor A
- (3) Hyderabad – Rank 5
- (4) Bhubaneshwar – Rank 5

24. What is the rank of Bhubaneshwar?

- (1) 3 (2) 5
- (3) 7 (4) 1

25. Who is the Mayor of Hyderabad?

- (1) B (2) A
- (3) E (4) F

Directions for questions 26 and 27: These questions are based on the following information.

Nine players—A through H—participated in a sporting event and the players are from the countries India, Pakistan and Australia, such that each of these countries is represented by three players. Further,

- (i) C and F belong to neither Pakistan nor Australia.
- (ii) E and H belong to the same country.
- (iii) A, B and D are from different countries.
- (iv) B and H are from Australia.

26. Which among the following statements can be false?

- (1) G is from Pakistan.
- (2) E is from Australia.
- (3) A is from India.
- (4) F is from India.

27. Which of the following combinations cannot be the group of people from the same country?

- (1) A, C and F (2) A, I and G
- (3) B, E and H (4) E, I and G

Directions for questions 28 to 30: These questions are based on the following data.

At the time of the annual day celebrations, the school management decided to honour the topper from each of the classes I to VII. So, they called the seven toppers Aakash, Bhanu, Chameli, David, Estar, Farha and Govind—and made them to sit in a row facing the audience, not necessarily in that order.

- (i) There were exactly two students between the toppers of class I and II.
- (ii) David who was the topper of class III is sitting at an extreme end and adjacent to Chameli, who is sitting to the left of David.

- (iii) Farha is the topper of class V and is sitting exactly at the middle of the row.
- (iv) The toppers of class II, VII and III are sitting together in the same order.
- (v) Bhanu and Farha are sitting together and Estar and Chameli are also sitting together.

28. Who is sitting to the immediate left of Chameli?

- (1) Aakash (2) Bhanu
(3) Estar (4) David

29. Who is the topper of class VI?

- (1) Aakash
(2) Govind
(3) Bhanu
(4) Cannot be determined

30. Who is the topper of class II?

- (1) Estar
(2) Bhanu
(3) Aakash
(4) Govind

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 4 | 4. 3 | 5. 4 | 6. 2 | 7. 1 | 8. 3 | 9. 1 | 10. 1 |
| 11. 3 | 12. 4 | 13. 1 | 14. 3 | 15. 1 | 16. 4 | 17. 4 | 18. 2 | 19. 2 | 20. 1 |
| 21. 1 | 22. 1 | 23. 4 | 24. 2 | 25. 3 | 26. 1 | 27. 2 | 28. 1 | 29. 2 | 30. 3 |

PRACTICE EXERCISE 11 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 2 | 3. 4 | 4. 4 | 5. 3 | 6. 3 | 7. 3 | 8. 4 | 9. 4 | 10. 1 |
| 11. 4 | 12. 1 | 13. 2 | 14. 4 | 15. 4 | 16. 3 | 17. 1 | 18. 3 | 19. 3 | 20. 4 |
| 21. 3 | 22. 1 | 23. 1 | 24. 4 | 25. 4 | 26. 3 | 27. 4 | 28. 3 | 29. 4 | 30. 1 |

Miscellaneous

Solved Examples

The questions based on word formation, number formation and sequencing are given in the following examples.

- How many meaningful words can be formed by using the first, the second, the fourth and the sixth letters of the word LAMENT using each letter exactly ones? If only one word can be formed then mark the last letter of that word as the answer. Mark Z as the answer if more than one such word can be formed. Mark M as the answer if no meaningful word can be formed.

- (1) E (2) T
(3) M (4) Z

☞ **Solution:** The first, the second, the fourth and the sixth letters of the word LAMENT are L, A, E and T respectively. The meaningful words that

can be formed with these four letters are LATE and TALE.

As more than one meaningful word can be formed, Z is the answer.

Choice (4)

- If the letters in the word DYNAMITE are rearranged in alphabetical order, how many letters remain in their position?

- (1) 0 (2) 1
(3) 2 (4) 3

☞ **Solution:**

Word: D Y N A M I T E

Rearranged

order: A D E I M N T Y

The two letters M and T remain in their positions.

Choice (3)

Logical Order of Words

These questions test the ability of the students to build up some logic among certain related group of words i.e., the

most probable sequence in which the words can be related. Let us study the following examples.

Solved Examples

- (1) Floods (2) Boats
(3) Rescue (4) Rains
(5) Shelter
(1) 5, 4, 1, 2, 3
(2) 4, 1, 2, 3, 5
(3) 3, 4, 2, 1, 5
(4) 4, 2, 1, 3, 5

☞ **Solution:** The above group of words refers to rescue operation during floods. They can be arranged in the order, (4, 1, 2, 3, 5), because when rains cause floods, then boats are used to rescue people and they are provided a shelter.

Choice (2)

- (1) Pollution (2) Science
(3) Global Warming (4) Vehicle
(5) Inventions
(1) 5, 2, 1, 4, 3
(2) 5, 2, 4, 1, 3
(3) 2, 1, 4, 3, 5
(4) 2, 5, 4, 1, 3

☞ **Solution:** The best logical order of the words is (2, 5, 4, 1, 3). Because knowledge of science leads to inventions. Vehicles are a type of invention. Vehicles cause pollution, which in turn causes global warming.

Choice (4)

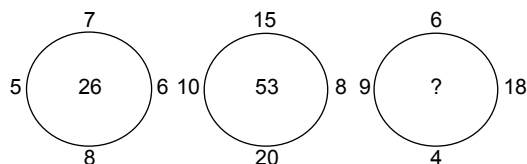
MISSING NUMBERS

Type I: Each question consists of 3 or 4 similar diagrams. All the given diagrams except one, is filled with numbers in a specific order. The numbers in each diagram are related among themselves through a particular mathematical operation(s). The candidate has to study the diagrams,

wherein all the numbers are given and find out the logic, i.e., the mathematical operation, through which the numbers are related. The logic derived should be such that, it should hold good for all the diagrams. By applying that logic to the diagram, which contains the question mark/blank, the missing number should be found out. Let us take the following illustrations for a better understanding.

Solved Examples

- Find the number which should come in place of the question mark (?).

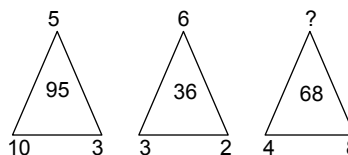


- (1) 43 (2) 31
(3) 37 (4) 39

☞ **Solution:** From the first diagram it can be observed that the number inside the circle is obtained by adding all the numbers that are around the circle. The same logic is applicable to the second diagram as well. Hence, by applying the logic to the third diagram, the missing number is $9 + 6 + 4 + 8 = 37$.

Choice (3)

- Find the number which should come in place of the question mark (?).



- (1) 2 (2) 4
(3) 5 (4) 3

☞ **Solution:** Here, the number inside the triangle is obtained by taking the product of the numbers at the vertices in pairs and then adding all the resulting values.

$$\text{i.e., } 95 = (10 \times 5) + (5 \times 3) + (3 \times 10)$$

$$36 = (3 \times 6) + (6 \times 3) + (2 \times 3)$$

$$68 = (4 \times ?) + (? \times 8) + (8 \times 4)$$

$$68 = 12 \times ? + 32$$

$$12 \times ? = 36 \therefore ? = 3.$$

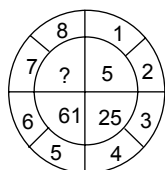
Choice (4)

Type II: In certain questions only one diagram, filled with numbers and a question mark is given. The numbers in the diagram form groups. In each group the numbers are

related in a specific manner. The task is to find the groups and then the missing number in one of the groups. The following illustration gives a clear idea.

Solved Examples

3. Find the number which should come in place of the question mark(?).



- (1) 113 (2) 137
(3) 91 (4) 87

☺ **Solution:** In the above diagram each of the two circles is divided into four sectors and each sector contains three numbers with a question mark in one of the sectors. The number in the inner circle in a particular sector is obtained by adding the squares of the numbers on the outer circle but in the same sector, i.e., $2^2 + 1^2 = 5$, $4^2 + 3^2 = 25$ and $5^2 + 6^2 = 61$

Hence, the missing number is $7^2 + 8^2 = 113$.

Choice (1)

4. Find the number which should come in place of the question mark(?).

7	4	8
16	10	?
23	14	26

- (1) 26 (2) 18
(3) 34 (4) 42

☺ **Solution:** The rectangle is divided into three columns. In each column, the third number is the sum of the two numbers above it i.e., $7 + 16 = 23$ and $4 + 10 = 14$. Hence, the missing number is $26 - 8 = 18$.

Choice (2)

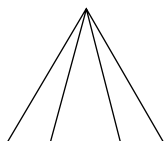
Certain questions test the students' ability to visualize simple figures in a complex figure. These questions contain a complex geometric figure and ask the student to count

number of triangles, squares etc., in the figure. The following examples illustrate the method of solving.

Solved Examples

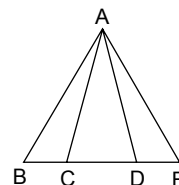
Directions for questions 1 and 2: Count the number of triangles in the given figure and choose the correct alternative from the given choices.

1.



- (1) 6 (2) 8
(3) 10 (4) 4

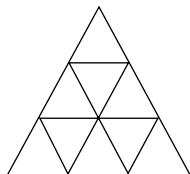
☺ **Solution:**



In all, there are 6 triangles namely $\triangle ABC$, $\triangle ACD$, $\triangle ADE$, $\triangle ABD$, $\triangle ACE$, $\triangle ABE$.

Choice (1)

2.



- (1) 15 (2) 9
(3) 10 (4) 13

☞ **Solution:** Number of triangles of 1×1 units = 9

Number of triangles of 2×2 units = 3

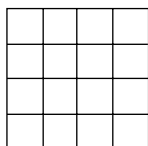
Number of triangles of 3×3 units = 1

\therefore Total = $(9 + 1 + 3) = 13$ triangles

Choice (4)

Directions for questions 3 and 4: Count the number of squares in the given figure and choose the correct alternative from the given choices.

3.



- (1) 16 (2) 20
(3) 30 (4) 29

☞ **Solution:** The given square is 4×4 grid

No. of 1×1 units = $(4 - 0) \times (4 - 0) = 16$

No. of 2×2 units = $(4 - 1) \times (4 - 1) = 9$

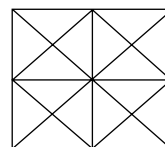
No. of 3×3 units = $(4 - 2) \times (4 - 2) = 4$

No. of 4×4 units = $(4 - 3) \times (4 - 3) = 1$

Total = 30.

Choice (3)

4.



- (1) 10
(2) 4
(3) 8
(4) 9

☞ **Solution:** The given figure is combination of two figures.

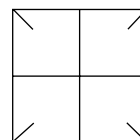


Figure (I)

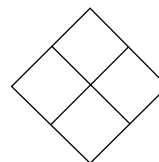


Figure (II)

Figure (I) is a 2×2 square grid

\therefore No. of squares in figure (I) = $1^2 + 2^2 = 5$

Figure (II) is also 2×2 square network

\therefore No. of square in figure (II) = $1^2 + 2^2 = 5$

\therefore Total no. of squares in the given figure = $5 + 5 = 10$.

Choice (1)

Data Sufficiency

Each problem contains a question and two statements I and II giving certain data. You have to select the correct answer from (1) to (4) depending on the sufficiency of data given in the statements to answer the question. Mark as your answer as

(1), if statement I alone is sufficient and statement II alone is not sufficient to answer the question.

(2), if statement II alone is sufficient and statement I alone is not sufficient to answer the question.

(3), if statements I and II together are sufficient but neither statement alone is sufficient to answer the question.

(4), if both statements I and II together are not sufficient to answer the question and additional data specific to the problem are needed.

Solved Examples

1. Ram is the tallest boy in the class. Is he the tallest student in the class?

- I. Reshma is the tallest girl in the class.
- II. Reshma is shorter than Ram.

👉 **Solution:** We cannot answer the question by using either only statement I or only statement II. However, by taking both the statements, we can conclude that Ram is the tallest student in the class.

Hence, the correct choice for this question is (4)

2. Does Ram's building have more than four floors?

- I. As per government regulations, all buildings with more than four floors should have a lift.

- II. Ram's building has a lift.

👉 **Solution:** By using both the statements together, we can only deduce that Ram's building may have more than four floors, but we cannot say that it DOES have more than four floors for sure, unless some additional information is there. (because it is not necessary that all buildings with a lift will have more than four floors. Even a building with two floors can have a lift). Hence, the answer is (4).

PRACTICE EXERCISE 12 (A)

Directions for questions 1 to 7: Select the correct alternative from the given choices.

- If with the help of 3, 5, 6, 11 and 12th letter of the word "CENTRALISATION", a word can be formed, then mark the middle letter of the word as your answer, otherwise mark X.
 (1) N (2) A
 (3) R (4) X
- If it is possible to form a meaningful word with the fifth, sixth, eighth and eleventh letters of the word REPRESENTATION, which letter will be the 3rd in that word? If more than one such word can be formed, give "M" as the answer, If no such word can be formed, give "X" as the answer:
 (1) S (2) E
 (3) M (4) X
- The first and the last letters of the word 'DARE' are replaced by the respective succeeding letter in the English alphabet and the other letters remain the same. What is the fourth letter of the word thus formed by jumbling the letters after the change? If no meaningful word can be formed, mark 'X' as your answer and if more than one word can be formed, mark 'N' as your answer.
 (1) X (2) R
 (3) E (4) N
- Find the number of meaningful words that can be formed by taking the fifth, the sixth, the eighth and the thirteenth letters from the word CONVALESCENCE, by using each letter only once. If only one meaningful word can be formed, mark the last letter of the word as your answer. If more than one meaningful word can be formed, mark your answer as K. If no meaningful word can be formed, mark your answer as Q.
 (1) S (2) Q
 (3) L (4) K
- If it is possible to form a meaningful word from the word RIGMAROLE using the fifth, sixth, eighth and ninth letters only once and if only one word can be formed, then mark 'R' as the answer; if two words can be formed having different beginning letters, then mark 'A' as the answer; if two words with same beginning letters can be formed, then mark 'L' as the

answer. If more than two words can be formed, mark 'E' as the answer.

- (1) R (2) A
(3) L (4) E
- If it is possible to make a meaningful word using the first letter twice, fourth letter once and sixth letter once of the word UTILIZATION, What is the first letter of that word? If two words can be formed mark the answer as X. If more than two words can be formed mark the answer as Y. If no such words can be formed give answer as 'Z'.
 (1) Z (2) Y
 (3) U (4) X
- How many five letter words can be formed by using the 11th letter, 7th letter, 5th letter, 10th letter and 2nd letter of the word INSTITUTION, such that each letter should be used exactly once in the word(s)?
 (1) One (2) Two
 (3) Three (4) None

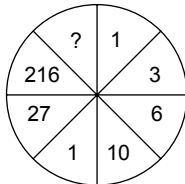
Directions for questions 8 to 15: In each question, a group of five words is given. From the answer choices, choose the one which gives the best logical order of the words.

- (1) Dog (2) Tiger
(3) Rat (4) Cat
(5) Wolf
 (1) 3, 4, 1, 5, 2 (2) 3, 4, 5, 1, 2
 (3) 3, 4, 2, 5, 1 (4) 3, 1, 4, 5, 2
- (1) Chapter (2) Paragraph
(3) Word (4) Alphabet
(5) Sentence
 (1) 4, 2, 3, 5, 1 (2) 4, 5, 3, 2, 1
 (3) 4, 3, 5, 2, 1 (4) 4, 1, 2, 3, 5
- (1) Sleep (2) Wood
(3) Carpenter (4) Cot
(5) Tree
 (1) 5, 3, 2, 4, 1 (2) 5, 4, 3, 2, 1
 (3) 5, 4, 2, 3, 1 (4) 5, 2, 3, 4, 1
- (1) Drink (2) Draw
(3) Water (4) Well
(5) Dig
 (1) 5, 4, 3, 2, 1 (2) 5, 3, 4, 2, 1
 (3) 5, 4, 2, 3, 1 (4) 5, 2, 3, 4, 1

12. (1) Country (2) District
(3) Village (4) State
(5) Taluk
(1) 1, 4, 5, 2, 3 (2) 1, 4, 2, 3, 5
(3) 1, 4, 3, 5, 2 (4) 1, 4, 2, 5, 3
13. (1) Earth (2) Jupiter
(3) Neptune (4) Mars
(5) Uranus
(1) 1, 5, 2, 3, 4 (2) 1, 4, 5, 3, 2
(3) 1, 2, 5, 3, 4 (4) 1, 4, 2, 5, 3
14. (1) President (2) General Manager
(3) Vice President (4) Assistant Manager
(5) Manager
(1) 1, 2, 3, 5, 4 (2) 1, 3, 2, 5, 4
(3) 1, 5, 2, 3, 4 (4) 1, 2, 5, 3, 4
15. (1) Man (2) Father
(3) Infant (4) Child
(5) Grand Father
(1) 3, 2, 1, 4, 5 (2) 3, 5, 4, 1, 2
(3) 3, 1, 2, 4, 5 (4) 3, 4, 1, 2, 5

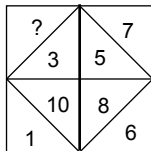
Directions for questions 16 to 24: In each of these questions, select the correct alternative from the given choices which should come in place of the question mark (?).

16.



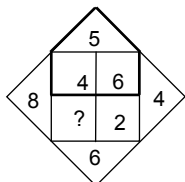
- (1) 100 (2) 256
(3) 512 (4) 1000

17.



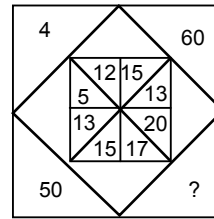
- (1) 9 (2) 11
(3) 1 (4) 4

18.



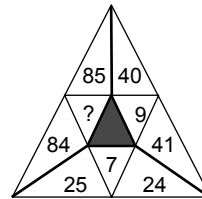
- (1) 5 (2) 12
(3) 6 (4) 8

19.



- (1) 50 (2) 55
(3) 60 (4) 65

20.



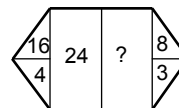
- (1) 11 (2) 13
(3) 15 (4) 17

21.

2	5	7	3
2	8	4	12
2	3	6	?

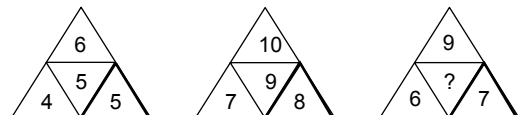
- (1) 9 (2) 4
(3) 0 (4) 13

22.



- (1) 10 (2) 11
(3) 13 (4) 16

23.



- (1) 0 (2) 4
(3) 7 (4) 8

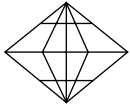
24.

13	17	442
7	11	154
19	23	?

- (1) 684 (2) 724
(3) 823 (4) 874

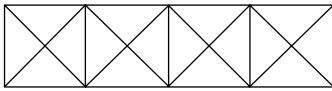
Directions for questions 25 to 28: Count the number of triangles in the given figures and choose the correct alternative from the given choices.

25.



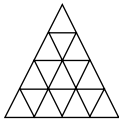
- (1) 42 (2) 44
(3) 48 (4) 50

26.



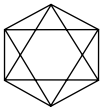
- (1) 28 (2) 24
(3) 32 (4) 38

27.



- (1) 26 (2) 22
(3) 25 (4) 16

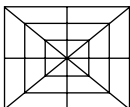
28.



- (1) 23 (2) 28
(3) 32 (4) 34

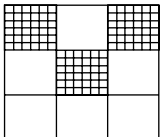
Directions for questions 29 to 32: Count the number of squares in the given figures and choose the correct alternative from the given choices.

29.



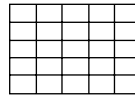
- (1) 15 (2) 10
(3) 12 (4) 8

30.



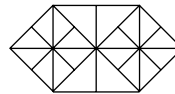
- (1) 300 (2) 287
(3) 252 (4) 284

31.



- (1) 45 (2) 40
(3) 55 (4) 20

32.



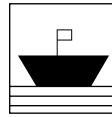
- (1) 9 (2) 12
(3) 8 (4) 15

Directions for questions 33 and 34: Select the correct alternative from the given choices.

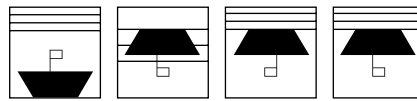
33. The mirror image of N A R E S H

- (1) H S E Я A И
(2) И A Я E 2 H
(3) N A Я E 2 H
(4) И A R E S H

34. Find the water image of figure (x)



(X)



(1) (2) (3) (4)

Directions for questions 35 to 40: Each problem contains a question and two statements which give certain data. You have to select the correct answer from (1) to (4) depending on the sufficiency of the data given in the statements to answer the question.

Mark 1: If statement I alone is sufficient to answer the question and statement II alone is not sufficient to answer the question.

Mark 2: If statement II alone is sufficient to answer the question and statement I alone is not sufficient to answer the question.

Mark 3: If statements I and II together are sufficient to answer the question, but neither statement alone is sufficient.

Mark 4: If statements I and II together are not sufficient to answer the question and additional data specific to the problem are needed.

35. What is the present age of Raman?

- I. After 6 years Raman would be twice his present age.
- II. Raman is 5 years older than his brother.

36. P and Q together have ₹35 and Q and R together have ₹45. What is the amount with P?

- I. Q has only ten rupee denomination notes.
- II. The amount with R is more than ₹25.

37. How many students are there in the class?

- I. Out of the total students in the class, 22 play football.

II. Out of the total students, 18 students play volleyball and 6 students play both football and volleyball.

38. What is the weight of Prakash?

- I. Prakash's weight is not less than 60 kg.
- II. If his weight is reduced by 5 kg, his weight is not more than 55 kg.

39. Who is the richest among A, B, C and D?

- I. D is richer than A and C.
- II. B is richer than A and C.

40. How many students are there in the class in which no two students got the same rank?

- I. A, who got 10th rank, is 17 ranks ahead of B, who is 3rd from the last in ranks.
- II. A is 19 ranks ahead of C.

PRACTICE EXERCISE 12 (B)

Directions for questions 1 to 7: Select the correct alternative from the given choices.

1. How many meaningful words can be formed using 1st, 3rd, 5th, 6th and 9th letters of the word "TRANSDUCER"?

- (1) Only one
- (2) Only two
- (3) Only three
- (4) Only four

2. What is the third letter of the word formed using fourth, sixth, eighth and tenth letters of the word 'SUPERFICIAL'. If no meaningful word can be formed, mark N as your answer and if more than one word can be formed, mark M as your answer.

- (1) C
- (2) F
- (3) E
- (4) M

3. If it is possible to make a meaningful word with the third, fifth, seventh and the eighth letters of the word INSTITUTION, which of the following will be the last letter of that word? If no such word can be formed, give 'X' as the answer. If more than one such word can be formed, give 'M' as the answer.

- (1) S
- (2) T
- (3) I
- (4) X

4. If it is possible to make a meaningful word from the word LOCOMOTIVE using its fifth, seventh, eighth and tenth letters, what is the first letter of the word? If more than one word can be formed, then mark 'L' as the answer. If no word can be formed, then mark 'O' as the answer.

- (1) L
- (2) I
- (3) M
- (4) E

5. If it is possible to make a meaningful word using the first letter twice, fourth letter once and sixth letter once of the word UTILIZATION, What is the first letter of that word? If two words can be formed mark the answer as X. If more than two words can be formed mark the answer as Y. If no such words can be formed give answer as 'Z'.

- (1) Z
- (2) Y
- (3) U
- (4) X

6. How many meaningful words can be formed using the 3rd, 5th, 6th, 8th, 9th and 13th letters of the word AUTHENTICATION only once. If only one word can be formed, then mark A as your answer; if two words can be formed having different beginning letters, then mark 'N' as your answer; if two words with the same beginning letters can be formed, then mark 'E' as your answer. If more than two words can be formed, mark 'T' as your answer.

- (1) T
- (2) N
- (3) E
- (4) A

7. If it is possible to make a meaningful word with the third, fifth, seventh and the eighth letters of the word INSTITUTION, which of the following will be the last letter of that word? If no such word can be formed, give 'X' as the answer. If more than one such word can be formed, give 'M' as the answer.

- (1) S (2) T
(3) I (4) X

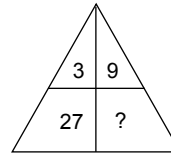
Directions for questions 8 to 15: In each question, a group of five words is given. From the answer choices, choose the one which gives the best logical order of the words.

8. (1) Appointment (2) Notification
(3) Interview (4) Selection
(5) Application
(1) 2, 3, 5, 4, 1 (2) 2, 4, 5, 3, 1
(3) 2, 5, 3, 4, 1 (4) 2, 1, 5, 4, 3
9. (1) Flowers (2) Sapling
(3) Pollimate (4) Seed
(5) Tree
(1) 5, 2, 1, 3, 4 (2) 5, 1, 2, 3, 4
(3) 1, 4, 3, 2, 5 (4) 1, 3, 4, 2, 5
10. (1) Shirt (2) Cut
(3) Stitch (4) Wear
(5) Cloth
(1) 5, 3, 2, 1, 4 (2) 5, 2, 3, 1, 4
(3) 5, 1, 2, 3, 4 (4) 5, 2, 1, 3, 4
11. (1) School (2) Bath
(3) Classroom (4) Uniform
(5) Brush
(1) 5, 2, 4, 3, 1 (2) 5, 4, 2, 1, 3
(3) 5, 2, 3, 1, 4 (4) 5, 2, 4, 1, 3
12. (1) Hospital (2) Doctor
(3) Treatment (4) Accident
(5) First Aid
(1) 4, 1, 5, 2, 3 (2) 4, 5, 3, 2, 1
(3) 4, 2, 1, 5, 3 (4) 4, 5, 1, 2, 3
13. (1) Court (2) Arrest
(3) Report (4) Punishment
(5) Burglary
(1) 5, 3, 2, 1, 4 (2) 5, 2, 3, 1, 4
(3) 5, 4, 3, 2, 1 (4) 5, 2, 4, 3, 1
14. (1) Octagon (2) Pentagon
(3) Triangle (4) Square
(5) Hexagon
(1) 3, 4, 2, 1, 5 (2) 3, 4, 5, 2, 1
(3) 3, 4, 5, 1, 2 (4) 3, 4, 2, 5, 1
15. (1) Car (2) Train
(3) Auto (4) Bike
(5) Lorry

- (1) 4, 3, 1, 5, 2 (2) 4, 3, 5, 1, 2
(3) 4, 3, 1, 2, 5 (4) 4, 5, 2, 3, 1

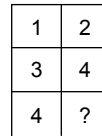
Directions for questions 16 to 24: In each of these questions, select the correct alternative from the given choices which should come in place of the question mark (?).

16.



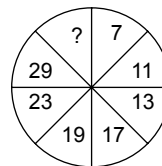
- (1) 729 (2) 18
(3) 343 (4) 243

17.



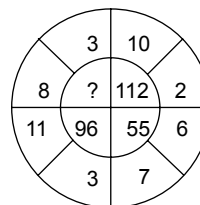
- (1) 5 (2) 6
(3) 7 (4) 3

18.



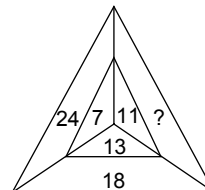
- (1) 37 (2) 41
(3) 31 (4) 43

19.



- (1) 23 (2) 78
(3) 64 (4) 13

20.



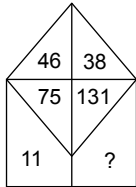
- (1) 12 (2) 20
(3) 30 (4) 42

21.

1	2	7
2	3	19
3	4	?

- (1) 31 (2) 43
(3) 48 (4) 37

22.



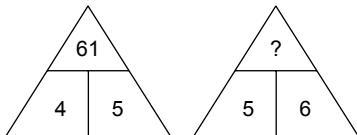
- (1) 11 (2) 13
(3) 18 (4) 16

23.

1	4	?	3
10	121	49	6

- (1) 4 (2) 9
(3) 25 (4) 16

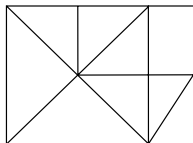
24.



- (1) 37 (2) 74
(3) 91 (4) 120

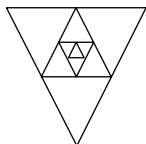
Directions for questions 25 to 28: Count the number of triangles in the given figures and choose the correct alternative from the given choices.

25.



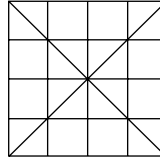
- (1) 15 (2) 18
(3) 20 (4) 12

26.



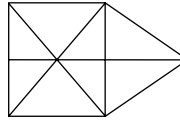
- (1) 13 (2) 16
(3) 18 (4) 27

27.



- (1) 24 (2) 38
(3) 30 (4) 36

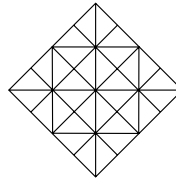
28.



- (1) 20 (2) 17
(3) 22 (4) 24

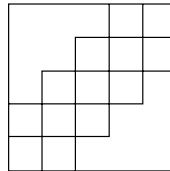
Directions for questions 29 to 32: Count the number of squares in the given figures and choose the correct alternative from the given choices.

29.



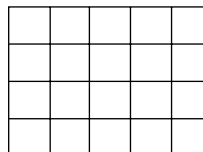
- (1) 30 (2) 20
(3) 35 (4) 40

30.



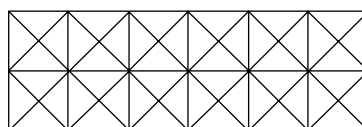
- (1) 13 (2) 17
(3) 19 (4) 20

31.



- (1) 45 (2) 40
(3) 50 (4) 60

32.



- (1) 32 (2) 27
(3) 38 (4) 26

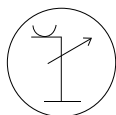
Directions for questions 33 and 34: Select the correct alternative from the given choices.

33. The mirror image of

EDUCATION

- (1) NOITACUDE (2) NOITACUDE
(3) NOITACUDE (4) NOITACUDE

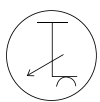
34. Find the water image of figure (X)



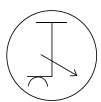
(X)



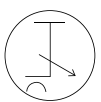
(1)



(2)



(3)



(4)

Directions for questions 35 to 40: Each problem contains a question and two statements which give certain data. You have to select the correct answer from (1) to (4) depending on the sufficiency of the data given in the statements to answer the question.

Mark 1: If statement I alone is sufficient to answer the question and statement II alone is not sufficient to answer the question.

Mark 2: If statement II alone is sufficient to answer the question and statement I alone is not sufficient to answer the question.

Mark 3: If statements I and II together are sufficient to answer the question, but neither statement alone is sufficient.

Mark 4: If statements I and II together are not sufficient to answer the question and additional data specific to the problem are needed.

35. Does Prabhakar get more salary than Raghu?

- I. The ratio of salaries of Prabhakar and Raghu is 3 : 2.
II. Raghu gets a salary of ₹2400 per month.

36. In a shop there are apples of different sizes. What is the minimum cost of one apple?

- I. The cost of one kg of apples is ₹63.
II. The minimum number of apples that can be weighted per kg is 6.

37. What is the total number of girls in the school?

- I. The number of boys in the school is 824.
II. The number of girls in the school is less than the number of boys.

38. Who gets more apples, A or B?

- I. There are 360 apples.
II. The apples are divided between A and B in the ratio 1 : 2.

39. Among P, Q and R, did R score least marks?

- I. P and Q together scored more than R.
II. The difference of marks of P and Q is more than R.

40. Are there 20 students in the class?

- I. The number of boys in the class is twice the number of girls.
II. The number of girls in the class is eight less than the number of boys.

ANSWER KEYS

PRACTICE EXERCISE 12 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 4 | 4. 4 | 5. 2 | 6. 1 | 7. 1 | 8. 1 | 9. 3 | 10. 4 |
| 11. 1 | 12. 4 | 13. 4 | 14. 2 | 15. 4 | 16. 4 | 17. 3 | 18. 4 | 19. 4 | 20. 2 |
| 21. 3 | 22. 1 | 23. 4 | 24. 4 | 25. 2 | 26. 4 | 27. 1 | 28. 3 | 29. 1 | 30. 4 |
| 31. 3 | 32. 4 | 33. 2 | 34. 4 | 35. 1 | 36. 3 | 37. 4 | 38. 3 | 39. 4 | 40. 1 |

PRACTICE EXERCISE 12 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 2 | 4. 1 | 5. 1 | 6. 4 | 7. 2 | 8. 3 | 9. 4 | 10. 2 |
| 11. 4 | 12. 4 | 13. 1 | 14. 4 | 15. 1 | 16. 1 | 17. 2 | 18. 3 | 19. 4 | 20. 2 |
| 21. 4 | 22. 2 | 23. 4 | 24. 3 | 25. 1 | 26. 1 | 27. 4 | 28. 2 | 29. 3 | 30. 4 |
| 31. 2 | 32. 3 | 33. 4 | 34. 3 | 35. 1 | 36. 4 | 37. 4 | 38. 2 | 39. 4 | 40. 1 |

Deductions and Connectives

In a number of competitive exams, there will be a few questions on “deductions”. Typically, here each question consists of two statements—on the basis of which a deduction has to be made. The answer has to be chosen from the given four (or five) choices and that will be the deduction made.

(If no conclusion can be drawn or the answer is not obtained, then the choice has to be marked which will normally be worded as “none of the above”).

These questions can be answered by representing the given statements by Venn Diagrams. However, here we will look at arriving at the deduction by using some simple rules.

First, let us look at some basic terms used in the rules and understand what they mean.

The two statements given in the question are called 'premises' and the answer, the conclusion.

E.g., All dogs are cats -- (i)
 All cats are Rabbits -- (ii)

These two statements are called ‘premises.’

Conclusion: All dogs are Rabits.

The premises normally start with the words All, No, Some and Some - Not.

The word “All” has its synonyms as—Every, Any, Each, whereas the word “Some” can also be replaced by Many, Few, A little, Most of, Much of, More, etc.

These words are referred to as qualifiers (also termed as quantifiers).

A premise consists of a subject and a predicate where-
in the first term [e.g., “dogs” in statement (i)] is the subject
and the second term [e.g., “cats” in statement (i)] the predi-
cate. Similarly, in statement (ii), “cats” is called the subject
and “Rabits” is the predicate.

The word that occurs in both the premises is known as the ‘middle term’ (“cat” in the example, given above). The answer or “conclusion” should consist of the other two words (“dogs” and “Rabbits” in the above example) and the middle term should not appear in the answer.

The premises can be divided into

- Universal statements and
- Particular statements

This classification of the premises into the above categories is dependent on the qualifier used in the premise. For example, the statements where “All” is used are called Universal statements and the statements where “Some” is used are called Particular statements.

Premises can also be divided into

- (i) Positive (affirmative) statements and
- (ii) Negative statements.

If there is a negative term like “not” or “no” in the statement, it is called a negative premise. Otherwise, it is called a positive premise or an affirmative statement.

The combination of the two different categories of classifications leads to four different premises as given in Table I below.

TABLE 1

	Affirmative	Negative
Universal	All A	No E
Particular	some; many I	some not; many not O

The subject or the predicate can be either distributed or not distributed in the given premise.

The subject and the predicate are either distributed (✓) or not distributed (x) depending on what kind of a statement it is (particular affirmative etc.). Table II shows the distribution pattern of the subject and the predicate.

TABLE 2

	Subject	Predicate
Universal affirmative	✓	×
Universal negative	✓	✓
Particular affirmative	×	×
Particular negative	×	✓

Note: ✓ indicates distributed.
× indicates undistributed.

Rules for Deductions

- [1] Every deduction should contain three and only three distinct terms.
- [2] The middle term must be distributed at least once in the premises.
- [3] If one premise is negative, then the conclusion must be negative.
- [4] If one premise is particular, then the conclusion must be particular.
- [5] If both the premises are negative, no conclusion can be drawn.
- [6] If both the premises are particular, no conclusion can be drawn.
- [7] No term can be distributed in the conclusion, if it is not distributed in the premises.

We take examples of each type and look at them in detail.

Example – I

All dogs are cats. -- (i)
All cats are Rabbits. -- (ii)

As the first statement is a Universal affirmative statement, the subject (dogs) has to be distributed (✓) and the

predicate (cats) is not distributed (x). As the second statement is also Universal affirmative, the subject cat is distributed (✓) and the predicate Rabbits is not distributed (x). The above answer/logic is arrived at on the basis of Table II.

The middle term (“cats” is the middle term as it occurs in both the premises) is distributed once in the premises. Hence it satisfies Rule [2]. As “dogs” is distributed in the premise and “Rabbits” is undistributed in the deduction also, they should appear accordingly. The type of statement that satisfies both of them is Universal affirmative statement, i.e., a statement with “All”. Hence the answer will be

All dogs are Rabbits.

The answer cannot be ‘All Rabbits are dogs’, because Rule [7] states that no term can be distributed in the conclusion if it is not distributed in the premises. As “Rabbits” is not distributed in the premise, it cannot be distributed in the conclusion (because if we take “All Rabbits are dogs”, then the subject “Rabbits” will be distributed). Hence, the conclusion “All Rabbits are dogs.” is wrong.

Example – II

All cats are dogs. -- (i)
All cats are Rabbits. -- (ii)

Statement (i) is Universal affirmative and hence the subject “cats” is distributed and the predicate “dogs” is not distributed as per Table II.

Statement (ii) is also Universal affirmative and hence the subject “cats” is distributed and the predicate “Rabbits” is not distributed as per Table II.

Here, the middle term “cats” (“cats” is the middle term as it is occurring in both the premises) is distributed; hence we can draw a conclusion.

The answer should contain the terms “dogs” and “Rabbits” and both the terms are not distributed. Referring to Table II, we find that this is possible only in Particular affirmative [the conclusion cannot start with the qualifier ‘All’ as the subject in “All” should be distributed]. According to Rule 7, a term cannot be distributed in the conclusion if it is not distributed in the premises. So the answer will be

Some dogs are Rabbits.
or
Some Rabbits are dogs.

Example – III

All dogs are cats. -- (i)
All Rabbits are cats. -- (ii)

Statement (i) is a Universal affirmative and hence the subject “dogs” is distributed and the predicate “cats” is not distributed. In statement (ii), which is also a Universal

affirmative, the subject “Rabits” is distributed and the predicate “cats” is not distributed. This is arrived at on the basis of Table II.

The middle term “cats” [“cats” is the middle term as it occurs in both the statements] is not distributed in either of the two statements. From Rule [2], which states that the middle term should be distributed at least once in the premises for drawing a conclusion, we cannot draw any conclusion in this case.

Example – IV

All cats are dogs. -- (i)

Some cats are Rabits. -- (ii)

The first statement is a Universal affirmative premise and hence the subject “cats” is distributed and the predicate “dogs” is not distributed (x). The second statement is Particular affirmative and hence both the subject “cats” and the predicate “Rabits” are not distributed (x) as per Table II. As we have a particular premise, the conclusion should also be a particular one as per Rule [4]. The middle term is distributed, hence we can draw a conclusion. So the answer will be

Some dogs are rabits.

or

Some rabits are dogs.

Example – V

All dogs are cats. -- (i)

No cats are Rabits. -- (ii)

As the first premise is a Universal affirmative, the subject (dogs) is distributed and the predicate (cats) is not distributed. In the second premise, which is a Universal negative, the first term (cats) and the second term (Rabits) are both distributed (as per Table II). As the middle term is distributed at least once in the premises, Rule [2] is satisfied and hence we can draw a conclusion.

From Rule [3], which states that if one of the premises is negative the conclusion should be negative, the conclusion should be negative and as both the terms “dogs” and “Rabits” are distributed, the conclusion should be a Universal negative statement. Hence the answer will be

No dogs are rabits.

or

No rabits are dogs.

Example – VI

All dogs are cats. -- (i)

Some cats are Rabits. -- (ii)

Since the first statement is a Universal affirmative, “dogs” is distributed and “cats” is not distributed. Since

the second statement is a Particular affirmative, “cats” is not distributed and “Rabits” is also not distributed (as per Table II).

In the above given example, no conclusion can be drawn, as Rule [2] states that the middle term (“cats” in the above example as it occurs in both the premises) should be distributed at least once in the premises, which is not satisfied.

Example – VII

All dogs are cats. -- (i)

Some cats are not rabits. -- (ii)

The first statement is a Universal affirmative and hence the subject (dogs) is distributed and the predicate (cats) is not distributed.

The second statement is a Particular negative and hence the subject (cats) is not distributed and the predicate (Rabits) is distributed (Table II).

But as the middle term (cats) is not distributed at least once in the premises, Rule [2] is not satisfied and hence we cannot draw any conclusion.

Example – VIII

All cats are dogs. -- (i)

Some cats are not rabits. -- (ii)

The first statement is a Universal affirmative and hence “cats” is distributed and “dogs” is not distributed. The second statement is a Particular negative and hence “cats” is not distributed and “Rabits” is distributed (as per Table II).

Here, the middle term (cats) is distributed and hence we can draw a conclusion.

The conclusion should be Particular negative as Rule [3] states that if a premise is negative, the conclusion should also be negative. Also Rule [4] states that if a premise is Particular, the conclusion should also be Particular. Hence, the conclusion should be a Particular negative.

In Particular negative, we know that the subject is not distributed and the predicate is distributed.

The terms “dogs” and “Rabits” should come in the conclusion. Also, since “dogs” is not distributed in the premise, it cannot be distributed in the conclusion, as per Rule [7].

As per the above reasoning, only “Rabits” can be the predicate in the conclusion and hence “dogs” will be the subject.

Thus the answer will be - Some dogs are not Rabits.

Example – IX

No dogs are cats. -- (i)

No cats are rabits. -- (ii)

We cannot draw any conclusion, as Rule [5] states that if both the premises are negative, we cannot draw any conclusion.

Example – X

- No dogs are cats. -- (i)
 Some cats are not rabbits. -- (ii)

As both the premises are negative, hence, as per Rule [5], we cannot draw any conclusion.

(Please note that the first premise is a Universal negative and hence the subject (dogs) is distributed and the predicate (cats) is also distributed as per Table II.

The second statement is a Particular negative and hence the subject (cats) is not distributed and the predicate (Rabbits) is distributed as per Table II).

Example – XI

- Some cats are not Rabbits. -- (i)
 Some cats are dogs. -- (ii)

As the first premise is a Particular negative, the subject (cats) is not distributed and the predicate (Rabbits) is distributed. In the second premise, both the subject and the predicate (cats and dogs respectively) are not distributed, since the premise is a Particular affirmative (as per Table II).

No conclusion can be drawn, as both the premises are particular as per Rule [6].

Example – XII

- Some cats are not dogs. -- (i)
 Some cats are not rabbits. -- (ii)

We cannot get an answer from the two premises, as Rule [5] states that from two negative premises, no conclusion can be drawn. Also, Rule [6] states that from two particular premises, no conclusion can be drawn.

Logical Connectives

In Logic, we deal with statements that are essentially sentences in English language. However, in Logic we are not interested in or worried about the factual correctness of the sentence. We are interested only in the Logical “truthfulness” of the statements.

For example, consider the statement:

“If the sun rises in the west, then the moon rises in the north.”

Here, we are not concerned with whether the sun rises in the east or west or with the direction in which the moon rises. We will only look at whether the moon will rise in the north or not *depending* on whether the part of the statement “The sun rises in the west” is true or not. If we are *given* that the sun rises in the west (which is factually incorrect), we can then conclude that the moon rises in the north (which again does not concern with the direction in which the moon actually rises).

We can represent statements in Logic using symbols like p, q, etc., the way we represent variables/unknowns in Algebra using symbols like x, y, z, etc.

Statements like “I will go for a movie”, “It is a sunny day”, etc., are called *simple statements*. When two or more such simple statements are connected together to form a single statement, such a statement is called a *compound statement*.

The simple statements are combined using *logical connectives* to form compound statements. We should know some of the important logical operators/connectives to be able to effectively tackle questions that involve compound statements and logical operations on compound statements.

Negation (“NOT”)

Any statement can be negated by using the words “not” or “no.” In layman’s language, negation is like the opposite of a statement.

For example, the negation of the statement “It is raining” is “It is NOT raining.”

The negation of the statement “He will pass the exam” is “He will not pass the exam.” This is equivalent to saying “He will FAIL in the exam.” So, when you are looking at negating the given statement, you should keep in mind the English equivalents of the statements also.

Logical Connective OR

Two or more statements can be connected using the connective OR. The following is an example using OR.

It is raining or I will go to my friend’s house.

The same statement can also be written as

Either it is raining or I will go to my friend’s house.

Both the statements above mean the same. The additional word “either” does not change the meaning of the statement.

When two (or more) statements are connected using OR, *at least one of them is true*.

Suppose we have a statement “Either p or q,” since at least one of the two statements p, q must be true, we have p *alone* is true or q *alone* is true or *both* are true.

This is the interpretation to be given to an OR statement (irrespective of the meaning of the sentence as per English language).

For example, the statement “Either I will go to a movie or I will go to my friend’s house” means

I will go to a movie

or

I will go to a friend’s house

or

I will go both for a movie and to a friend’s house

followed by q ” and “Negation q followed by p ” will be correct combination of statements. Hence, we directly check out for NOT $p \rightarrow q$ or NOT $q \rightarrow p$ in the answer choices.

In the above example, we should look for BC or DA.

Logical Connective AND

Two or more statements can be connected using the connective AND. The following is an example using AND.

It is raining and I will go to my friend's house.

The two statements connected by and have to be true for the compound statement to be true. In general, if we have a statement “ p and q ” then we can conclude that p should be true as well as q , that is, both the statements should be true. Even if one of the two statements is false, the compound statement is false.

Negation of compound statements formed with OR, AND

A compound statement formed with OR or AND can be negated in the following manner:

“Negation (p OR q)” is the same as “Negation p AND Negation q ”

“Negation (p AND q)” is the same as “Negation p OR Negation q ”

As can be seen in the above example, when a compound statement consisting of two simple statements (connected with OR or AND) is negated, the result will consist of each of the individual statements negated. In addition to that, the following will also have to be observed:

OR will become AND

AND will become OR

Logical connective IF—THEN

This is a very important connective. This is represented by $p \rightarrow q$ (and is read as “ p implies q ”). This means that if we know that p has occurred, q has to occur or must have occurred. For example, the statement “If it is raining, then I wear a raincoat” means that if we know that it is raining, we can conclude that I must be wearing a raincoat.

The statement “ p implies q ” is called an implication statement. The term on the left hand side in $p \rightarrow q$ is called the “antecedent” and the term q is called the “consequent”.

Let us look at the following cases when we are given that $p \rightarrow q$

- i) Given that $p \rightarrow q$, we are then told that q has occurred. Can we conclude that p must have occurred?

We CANNOT conclude that p must have occurred. This is because while whenever p occurs, q will definitely occur, q may occur even otherwise, that is, even without the occurrence of p . So, both p and Negation p are possible and hence, we cannot conclude anything when we know that q has occurred.

- ii) Given that $p \rightarrow q$, we are then told that p has not occurred. Can we conclude that q will also not occur?

We CANNOT conclude that q will not occur. This is because while whenever p occurs, q will definitely occur, q may occur even p does not occur (as discussed above). So, both q and Negation q are possible, and hence we cannot conclude anything when we know that p has not occurred.

- iii) Given that $p \rightarrow q$, we are then told that q has not occurred. Can we conclude that p must not have occurred?

We CAN conclude that p must not have occurred. This is because had p occurred, q WOULD have occurred but we know that q has not occurred. So, p MUST NOT have occurred. So, we can conclude that “Negation p ” follows “Negation q .”

So, if we are given that $p \rightarrow q$, then “Negation $q \rightarrow$ Negation p .” This is a very important relationship. We can express it in words as

“In an implication statement, negation of the right hand side will always imply the negation of the left hand side.”

We can summarize the above three points as follows:

$p \rightarrow q$	Given
$q \rightarrow p$	Cannot be concluded
$q \rightarrow$ Negation p	Cannot be concluded
Negation $p \rightarrow$ Negation q	Cannot be concluded
Negation $p \rightarrow q$	Cannot be concluded
Negation $q \rightarrow$ Negation p	Is always true

Let us take an example and understand these questions. The directions are the same as that we looked at above, that is,

“Each question has a main statement followed by four statements labelled A, B, C and D. Choose the ordered pair of statements where the first statement implies the second, and the two statements are logically consistent with the main statement.”

2. If the elephant is big then the lion is cruel.

- A. The elephant is big.
B. The elephant is not big.
C. The lion is cruel.
D. The lion is not cruel.

- (1) CA (2) BD
(3) BC (4) DB

✎ **Solution:** The main statement has two simple statements “The elephant is big” and “The lion is cruel” connected by “IF—THEN.” Let us call these

two statements p and q respectively for the purpose of our discussion. Then the main statement can be represented as “ p implies q ” or “ $p \rightarrow q$.”

First, let us look at each choice and understand the logic discussed above. ONCE WE DO THAT, WE WILL ALSO SEE HOW TO ANSWER SUCH QUESTIONS IN A MUCH SHORTER TIME.

Take choice (1). In terms of p and q , this can be represented as $q \rightarrow p$. As per the table above, we know that this CANNOT be concluded given $p \rightarrow q$. Hence, this is not the correct answer.

Take choice (2). In terms of p and q , this can be represented as “Negation $p \rightarrow$ Negation q .” Again, as per the table above, we know that this CANNOT be concluded given $p \rightarrow q$. Hence, this is not the correct answer.

Take choice (3). In terms of p and q , this can be represented as “Negation $p \rightarrow q$.” As per the table above, we know that this CANNOT be concluded given $p \rightarrow q$. Hence, this is not the correct answer.

Since we eliminated three answer choices, the fourth has to be the correct answer. Let us take choice (4) and look

at it. In terms of p and q , it can be represented as “Negation $q \rightarrow$ Negation p .” As per the table above, we know that this can definitely be concluded. Hence, this is the correct answer choice.

Approach in the exam

In an exam, for these types of questions, we do not need to go from the answer choices and check each and every one of them. We can directly identify the combinations of statements that will satisfy the directions given.

Given that $p \rightarrow q$, we know that “Negation $q \rightarrow$ Negation p .” Hence, the two correct combinations are “ pq ” (because this is the given statement itself) and “Negation $q \rightarrow$ Negation p .”

So, in the above example, we should look for AC or DB. Hence, the correct answer is choice (4).

Other forms of IF—THEN

There are different types of statements which can be reduced to or represented as $p \rightarrow q$. Let us look at these statements in descriptive form and the representation by using “ \rightarrow ” sign.

S. No.	Statement	Representation using \rightarrow	Also equivalent to	Remarks
1.	If p then q	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Already discussed above
2.	q if p	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Identical to 1 above
3.	When p , then q Whenever p , then q	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Identical to “if p then q ”
4.	q when p q whenever p	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Same as 3 above
5.	Everytime p , q	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Same as “If p , then q ”
6.	q everytime p	$p \rightarrow q$	Neg. $q \rightarrow$ Neg. p	Same as 5 above
7.	q only if p	$q \rightarrow p$	Neg. $p \rightarrow$ Neg. q	
8.	Unless p , q	Negation $p \rightarrow q$	Neg. $q \rightarrow p$	
9.	q unless p	Negation $p \rightarrow q$	Neg. $q \rightarrow p$	Same as 8. Above
10.	p otherwise q	Negation $p \rightarrow q$	Neg. $q \rightarrow p$	Same as “Unless p , q ”

PRACTICE EXERCISE 13 (A)

Directions for questions 1 to 3: Each of the following questions contains a pair of statements. Consider the statements to be true even though they are at variance from the commonly known facts. Find out few possible conclusions that can be logically drawn from these statements.

1. All rupees are notes.
All notes are papers.
2. Some countries are islands.
No islands are drought prone.
3. All mixers are grinders.
Some mixers are not juicers.

Directions for questions 4 to 6: In each of these questions, two statements are given followed by two conclusions numbered I and II. Consider the given statements to be true even if they seem to be at variance from the commonly known facts. Read the conclusion and then decide which of the conclusion(s) logically follow(s) from the given statements. Mark your answer as

- (1) if only I follows.
 - (2) if only II follows.
 - (3) if both I and II follow.
 - (4) if neither I nor II follows.
4. Statements:
Some lands are fertile
Some fertile are not cultivable.
Conclusions:
I. Some lands are not cultivable.
II. No cultivable is land.
 5. Statements:
Some sugars are powder.
All sugars are fattening.
Conclusions:
I. All powders are fattening.
II. Some fattening are powders.
 6. Statements:
All melodies are classical.
Some swaras are not classical.
Conclusions:
I. Some melodies are not swaras.
II. Some swaras are not melodies.

Directions for questions 7 to 9: Each of these questions consists of six statements followed by four sets of three statements each. Select as your answer the set in which the third statement logically follows the first two statements.

7. A. No mute is deaf.
B. Some deaf persons are not dull.
C. All dull persons are mute.
D. Some dull persons are mute
E. No deaf person is mute.
F. No deaf person is dull.
(1) FAD (2) DAB
(3) CAF (4) FCE
8. A. No artificer is a craftsman.
B. All artificers are artisans.
C. Some artisans are not craftsman.
D. Some artisans are sculptors.
E. Some sculptors are not craftsman.
F. Some artificers are sculptors.
(1) ABC (2) CDE
(3) DBF (4) CED
9. A. Some rifles are not pistols.
B. All cannons are guns.
C. No gun is a pistol.
D. Some cannons are rifles.
E. Some guns are rifles.
F. Some guns are not rifles.
(1) BDF (2) ECA
(3) ACE (4) CFA

Directions for questions 10 to 12: Each of these questions consists of six statements followed by four sets of three statements each. Select as your answer the set in which the statements are logically related.

10. A. Some tufts are combs.
B. All crests are combs.
C. No crest is tuft.
D. All crests are tufts.
E. Some crests are not combs.
F. Some tufts are not combs.
(1) ABD (2) ABC
(3) EDA (4) BCF

11. A. Some desks are not decks.
 B. No slope is desk.
 C. Some slopes are desks.
 D. No desk is a deck.
 E. No slope is decks.
 F. All desks are slopes.
 (1) CDE (2) DEF
 (3) ABE (4) BDE
12. A. Engineers are not doctors.
 B. Some doctors are psychologists.
 C. Some doctors are not professors.
 D. Some engineers are professors.
 E. No professor is a psychologist.
 F. Some psychologists are not engineers.
 (1) ACD (2) DEF
 (3) BFA (4) None of the above

Directions for questions 13 and 14: These questions are based on the following statements.

All booths are cabins.

Some dens are not cabins.

All hovels are booths.

13. Which of the following statement contradicts the conclusion of the above three statements?
 (1) All dens are hovels.
 (2) Some dens are hovels.
 (3) Some dens are not hovels.
 (4) No den is a hovel.
14. If few kraals are hovels, then which of the following is definitely false?
 (1) Few dens are not kraals.
 (2) Few kraals are not dens.
 (3) Few kraals are dens.
 (4) No kraal is a cabin.

Directions for questions 15 and 16: These questions are based on the following statements.

No individuality is a character.

Few characters are peculiarities.

Personality is individuality.

15. Which of the following statements contradicts the conclusion of the above three statements?
 (1) All personalities are peculiarities
 (2) All peculiarities are personalities
 (3) No personalities are peculiarities
 (4) Few peculiarities are personalities.

16. If no personality is unicity, then which of the following is definitely true?
 (1) Unicity is peculiarity.
 (2) Few unicities are peculiarities
 (3) No unicity is peculiarity.
 (4) None of these

Directions for questions 17 and 18: In each of the following questions, select the option which is definitely true based on the given statements.

17. In an organization, all the managers have cars but no manager has a bike. All persons who have cars are executives.
 (1) All executives have bikes.
 (2) No executive has bike.
 (3) Some executives do not have bikes.
 (4) Some executives have bikes.
18. In a school, all the intelligent students are sharp as well as clever. All the students who are clever score more than 90% marks and no dull student is clever.
 (1) Few dull students are intelligent.
 (2) No sharp student is dull.
 (3) No dull student scores more than 90% marks.
 (4) Few sharp students are not dull.

Directions for questions 19 to 22: Each question below consists of a main statement followed by four numbered statements. From the numbered statements, select the one that logically follows the main statement.

19. If Sania wins, then her rank improves.
 (1) Sania's rank improved, implies that she won.
 (2) Sania did not win, hence her rank does not improve.
 (3) Sania's rank did not improve, implies that she did not win.
 (4) Sania won, hence her rank will not improve.
20. Whenever the parents are away, I freakout.
 (1) I freaked out, means that the parents are away.
 (2) Parents are away, hence I will freakout.
 (3) Parents are not away, hence I will not freakout.
 (4) Both (2) and (3)
21. Either India wins ODI or loses tests.
 (1) India lost the ODI implies that it wins tests.
 (2) India won the tests implies that India wins ODI.
 (3) India did not win ODI, hence it loses tests.
 (4) India did not lose tests, means that India loses ODI.

22. Only if the aesthetic sense prevails, then corruption vanishes.
- Aesthetic sense prevailed, means that corruption vanished.
 - Corruption did not vanish, implies that aesthetic sense did not prevail.
 - Aesthetic sense did not prevail, hence corruption vanishes.
 - Corruption vanished, implies that aesthetic sense prevailed.

Directions for questions 23 to 27: In each question, there is a main statement followed by four statements A, B, C and D. From the choices, choose the ordered pair in which the first statement implies the second statement and the two are logically consistent with the main statement.

23. If you attend the party, then I will introduce you to them.
- You have attended the party.
 - You did not attend the party.
 - I will introduced you to them.
 - I will not introduced you to them.
- AB
 - BD
 - CA
 - DB
24. Either Ram or Laxman will deliver the book.
- Ram delivered the book.
 - Laxman delivered the book.
 - Ram did not deliver the book.
 - Laxman did not deliver the book.
- BC
 - DA
 - CD and AB
 - CB and AD
25. Unless your will is strong, you will not fulfil.
- Your will is not strong.
 - You will not fulfil.
 - Your will is strong.
 - You will fulfil.
- AB
 - CD
 - BA
 - AD
26. The government will be in place, only if there is fair poll.
- The government is not in place.
 - There is fair poll.
 - The government is in place.
 - There is no fair poll.
- AD
 - BC
 - BD
 - CB
27. Lara creates history, whenever he is in form.
- Lara is not in form.
 - Lara did not create history.
 - Lara creates history.
 - Lara is in form.
- CD
 - BA
 - CD and AB
 - DC and BA
- Directions for questions 28 to 30:** Each question given below is a statement followed by four different statements. Choose the one which is the correct negation of the given statement.
28. Either Anand will marry Vandana or Madhavi will marry Kollol.
- Anand does not marry Vandana, so Madhavi marries Kollol.
 - Neither Anand marries Vandana nor Madhavi marries Kollol.
 - Madhavi does not marry Kollol but Anand marries Vandana.
 - None of these
29. Whenever Bhiru and Basanti go for long drive, Joy follows them.
- Joy follows Bhiru and Basanti but they are not going for a long drive.
 - Bhiru and Basanti are going for long drive and Joy follows them.
 - Joy does not follow Bhiru and Basanti even when they go for long drive.
 - None of these
30. Pratap Rana will attend the class, only if his father allows him to go by bike.
- Pratap Rana is not attending the classes even his father allows him to come by bike.
 - Pratap Rana's father did not allow him to go by bike but he was attending the class.
 - Pratap Rana is not attending the classes because his father did not allow him to go on bike.
 - None of these

PRACTICE EXERCISE 13 (B)

Directions for questions 1 to 4: Each of these questions consists of six statements followed by four sets of three statements each. Select as your answer the set in which the third statement logically follows the first two statements.

1. A. Few afflictions are austerities.
B. Few situations are not austerities.
C. Few adversities are austerities.
D. Few situations are not afflictions.
E. All Austerities are situations.
F. Every adversity is an affliction.
(1) DAB (2) DEA
(3) AED (4) CFA
2. A. Passion is hobby.
B. Zeal is passion.
C. Few hobbies are passions.
D. Few hobbies are not zeals.
E. No passion is hobby.
F. Few zeals are not passions.
(1) ABD (2) DFA
(3) AFC (4) BED
3. A. No agitation is ardor.
B. Few ardors are not fervours.
C. No fervour is ardor.
D. Few ardors are agitations.
E. All agitations are fervours.
F. Many fervours are ardors.
(1) EAC (2) EDF
(3) DBE (4) BED
4. A. All acclaims are accolades.
B. No acknowledgement is an acclaim.
C. Few acknowledgements are not accolades.
D. Few accolades are acclaims.
E. Some acknowledgements are not acclaims.
F. No accolade is an acknowledgement.
(1) ABF (2) DFE
(3) CAE (4) DEC

Directions for questions 5 to 8: Each of these questions consists of six statements followed by four sets of three statements each. Select as your answer the set in which the statements are logically related.

5. A. Few straps are not curbs.
B. Some curbs are not chains.

- C. All curbs are chains.
D. Many straps are chains.
E. Many chains are curbs.
F. Some straps are not chains.
(1) ACF (2) ABF
(3) DAE (4) AFE

6. A. No dogma is a belief.
B. Few beliefs are dogmatic.
C. Some dogmatics are not dogmas.
D. Few dogmatics are dogmas.
E. Many beliefs are not dogmatic.
F. Some beliefs are dogmas.
(1) ABD (2) ACE
(3) CBA (4) BDF

7. A. Shed is not shelter.
B. Roof is protection.
C. Roof is shed.
D. Roof is shelter.
E. Some shelter is not protection.
F. Shed is protection.
(1) CDA (2) AEF
(3) BCF (4) None of these

8. A. All cricketers are footballers.
B. All footballers are magicians.
C. All magicians are cricketers.
D. Some cricketers are footballers.
E. Some footballers are magicians.
F. Some magicians are cricketers.
(1) ABC (2) EFB
(3) BCD (4) DEF

Directions for questions 9 and 10: These questions are based on the following statements.

Changes are ideas.

No idea is a fancy.

Most fancies are images.

9. Which of the following statement contradicts the conclusion of the above three statements?
(1) Few images are changes
(2) No image is change.
(3) All changes are not images.
(4) All images are changes.

10. If change is an imagination, then which of the following is definitely true?

- (1) Few imaginations are images.
- (2) Few imaginations are not fancies.
- (3) Few images are not imaginations.
- (4) Few images are imaginations.

Directions for questions 11 and 12: These questions are based on the following statements.

Drift is gist.

Few twists are drifts.

All gists are thrusts.

11. Which of the following statements contradicts the conclusion of the above three statements?

- (1) Few twists are not thrust.
- (2) Few thrusts are not twists.
- (3) No thrusts are twists
- (4) All thrusts are sense.

12. If no gist is light, then which of the following is definitely true?

- (1) No light is thrust.
- (2) No twist is a light.
- (3) Some lights are not thrust.
- (4) No drift is a light.

Directions for questions 13 to 15: In each of the following questions, four statements are given. All the statements should be considered to be true, even though they vary from the commonly known facts. Exactly three of the statements among the given choices can be true. Find the one that must always be false.

13. All devils are evils. Man is a devil. Few women are not evils. All beings are devils.

- (1) All women are men.
- (2) Few women are men.
- (3) Few women are beings.
- (4) No being is women.

14. All teachers are students. No student is a clever. Few clevers are intelligent. All teachers are dull.

- (1) Few intelligent are not clevers.
- (2) Few clevers are not teachers.
- (3) No dull is clever.
- (4) No student is dull.

15. All flowers are beautiful. Few flowers are roses. All roses are red. No jasmine is a rose.

- (1) Few roses are beautiful.
- (2) No flower is red.

(3) Some jasmines are not flowers.

(4) Few red are beautiful.

Directions for questions 16 and 17: Select the correct alternatives from the given choices.

16. The H.R. manager of TCS will come, if the strike does not effect the flight timings. Only if the HR manager of TCS comes, TCS will recruit people.

TCS is recruiting people implies that

- (1) the strike effects the flight timings.
- (2) the strike does not effect the flight timings.
- (3) the HR manager of TCS does not come.
- (4) None of these.

17. When the Infosys team's performance is excellent, then Infosys will become the top IT company. Either Infosys does not become the top IT company or TCS remains in the top rank.

The Infosys team's performance is excellent, means that

- (1) TCS remains in the top rank.
- (2) TCS will not remain in the top rank.
- (3) Infosys will be in the top rank.
- (4) None of these

Directions for questions 18 to 22: Each question below consists of a main statement followed by four numbered statements. From the numbered statements, select the one that logically follows the main statement.

18. If the teacher is in the class, then the children will either read or keep quiet.

- (1) The children will not read or will not keep quiet, implies that the teacher is not in the class.
- (2) If the teacher is not in the class, then the children will not read and will not keep quiet.
- (3) The children will not read and will not keep quiet, implies that the teacher is not in the class.
- (4) If the teacher is not in the class, then the children will not keep quiet or will not read.

19. Whenever an earthquake occurs, either a tsunami or a volcanic eruption takes place.

- (1) If a volcanic eruption or a tsunami takes place, then an earthquake must have occurred.
- (2) If a volcanic eruption did not occur and a tsunami did not occur, then an earthquake did not occur.
- (3) If an earthquake does not occur, neither a tsunami nor a volcanic eruption takes place.
- (4) If earthquake occurs and volcanic eruption takes place, then tsunami does not occur.

- Directions for questions 23 to 27:** Each question has a main statement followed by four statements labelled A, B, C and D. Choose the ordered pair of statements where the first statement implies the second, and the two statements are logically consistent with the main statement.

24. Either the patient dies or is in coma.
- A. The patient dies.
 - B. The patient is in coma.
 - C. The patient is alive.
 - D. The patient is not in coma.
- (1) BA (2) DA
(3) BC (4) DC
25. Either the Everest is tall or the Pacific is deep.
- A. The Everest is tall.
 - B. The Everest is not tall.
 - C. The Pacific is deep.
 - D. The Pacific is not deep.
- (1) AC (2) DB
(3) BC (4) AD
26. Either the tank has a leak or the outlet is open.
- A. The tank does not have a leak.
 - B. The outlet is open.
 - C. The outlet is not open.
 - D. The tank has a leak.
- (1) CA alone
(2) CD alone
(3) DC and BA
(4) CD and AB
27. The ornament is made of gold or silver.
- A. The ornament is made of silver.
 - B. The ornament is not made of gold.
 - C. The ornament is not made of silver.
 - D. The ornament is made of gold.
- (1) BA (2) DC
(3) CB (4) AD

28. The presentation was lengthy but simple.
 - (1) The presentation was not lengthy and not simple.
 - (2) The presentation was lengthy but not simple.
 - (3) The presentation was not lengthy or not simple.
 - (4) The presentation was simple but not lengthy.
29. Unless Tarun learns the basics, he cannot solve connectives.
 - (1) Tarun learned the basics but he could not solve connectives.

- (2) Tarun did not learn the basics, but he could solve connectives.
- (3) Tarun learned basics and solved connectives.
- (4) Tarun did not learn basics and he did not solve connectives.

30. He either goes to US or he will join in a job.

- (1) He went to US and did not join in a job.
- (2) He went to US but joined in a job.
- (3) He did not go to US and joined in a job.
- (4) He did not go to US and did not join in a job.

ANSWER KEYS

PRACTICE EXERCISE 13 (A)

- 1. All rupees are papers.
- 2. Some countries are drought prone.
- 3. (i) Some juices are not mixtures
(ii) All grinders are not juicers
(iii) Some grinders are juicers as well as juicers.

4. 4	5. 2	6. 2	7. 3	8. 1	9. 2	10. 1	11. 2	12. 3	13. 1
14. 4	15. 2	16. 4	17. 3	18. 4	19. 3	20. 2	21. 3	22. 4	23. 4
24. 2	25. 1	26. 4	27. 4	28. 2	29. 3	30. 2			

PRACTICE EXERCISE 13 (B)

1. 4	2. 4	3. 2	4. 3	5. 1	6. 3	7. 3	8. 3	9. 4	10. 2
11. 3	12. 4	13. 1	14. 4	15. 2	16. 4	17. 1	18. 3	19. 2	20. 4
21. 1	22. 4	23. 4	24. 2	25. 3	26. 4	27. 1	28. 3	29. 2	30. 4

Statements and Assumptions

In these questions, a statement is given followed by some assumptions. The student is required to assess the assumptions and decide which of them is implicit in the given statement. Before we go further, it is imperative for us to understand the meanings of the terms statements and assumptions.

Statement:

At the simplest level, a statement is a formal account of certain facts, views, problems or situations expressed in words.

Assumption:

An idea which is thought to be true, or certain to happen, but is not explicitly stated or supported by facts.

Implicit: Something that is suggested or is to be understood, though it is not plainly expressed.

In our day to day affairs, we make a lot of statements as part of our communication process. As the communication process evolved over time, brevity became the norm as statements became smaller and crisper, yet they continued to carry the same meaning.

In this kind of communication, the speaker/author leaves certain ideas unsaid, those which he takes for granted, which work as a link between a statement and a conclusion. These unsaid ideas are on the speaker/author's mind before making a statement. These unsaid ideas are very much implied in the statement.

To understand the above, let us assume that your friend has applied for a competitive exam. You saw him

working hard, preparing for that exam. It is a natural reaction to say that, 'He is working hard, he will be successful'. Here, you are co-relating two different aspects. 'Working hard' and 'succeeding'. How can you relate these two? Obviously by **ASSUMING** that hardwork is necessary to attain success.

Normal way of expression	Expression intended
1. He is working hard.	1. He is working hard.
	2. Those, who work hard, succeed. [This sentence is taken for granted].
3. He will be successful	3. He will be successful.

Approach to the Question

The words used in the statements and the format of the statements give some clue in evaluating the assumption.

(i) Key words

Words like 'all', 'only', 'every', etc., are definitive in nature, whereas words like 'some', "a few", "many", etc., are not. Therefore, one should differentiate between statements like "use entire time for studies" and "use some time for studies". The following example would help in interpreting the key words.

Example 1:

Statement: The Indian Hockey team is unable to rise to the occasion. The team should be trained by the army.

Assumptions:

- I. Army training is the best method available to improve the present performance of the Indian Hockey team.
- II. Army training is a reasonably good solution to solve the existing problem.
- III. Army training is the only solution to come out of the present problems that the Indian Hockey team is facing.
- IV. Army training will definitely put the Indian Hockey team on the winning track.
- V. Army training would probably solve the performance based problems in the Indian Hockey team.

In this example, only assumptions II and V are valid assumptions, because assumptions I, III and IV use definitive words such as 'best', 'only' and 'definitely' respectively.

Statements II and V consists of a suggestion to solve the problem. The speaker, definitely, feels that 'Army Training' would help the Hockey team to overcome its performance related problems, but the statement does not give any clue that army training is the best or only or definitely an effective solution to the given problem.

(ii) Notice/Appeal/Advertisement

Sometimes the statement is in the form of a notice or appeal for an advertisement. In these cases, the following are the valid assumptions.

1. In case of notice/appeal/ advertisement, it will have some response.
2. In case of an official notice, if what is mentioned therein is implemented, it will have a beneficial effect for the organization and there is a need to issue it.
3. In case of an appeal or public interest notice, the implementation of it will be beneficial to the people and non-implementation may cause harm.
4. In case of an advertisement, what is being highlighted is looked forward to by the people.
5. In case of a public interest notice, it is the duty of the person/authority to issue such a notice.
6. In case of an appeal, the reason for issuing such an appeal exists.

The following examples give clarity to the above explanation.

Example 2:

Statement:

"Join our training institute to become a master in reasoning". An advertisement.

Valid assumptions:

- I. At least some people would respond to the advertisement.
- II. People look forward to becoming a master in reasoning.

Example 3:

Statement:

"Donate money for flood relief", an appeal.

Valid assumptions:

- I. At least some people would respond to the appeal.
- II. There were floods and the condition of flood- effected people is pitiable.

(iii) Existence/Non-Existence of the subject

If the speaker is talking about a hypothetical or an unestablished object/idea, he does so with an assumption that such a thing exists. Similarly, if its absence is being talked about, it is assumed 'not existing'.

Example 4:

Statement:

Marriages are made in heaven.

Valid assumption:

Heaven exists.

(iv) Cause-Effect

Some statements suggest a cause-and-effect relationship. The conjunction between the clauses are normally, 'hence', 'as', 'therefore', 'thus', etc. In all such cases the valid assumption is "this cause leads to this effect". These statements can be of the form, "though cause, yet no effect", "because no cause, hence no effect", etc.

Example 5:

Statements:

The weather is bad. The match will be cancelled.

Valid assumption:

Matches cannot be played in bad weather.

Analysis:

Here the speaker is connecting bad weather and a match. He assumes that the cause, i.e., bad weather, would lead to the effect, i.e., match being cancelled. Hence, the underlying assumption is that 'matches cannot be played in bad weather'.

(v) Suggestions

Certain statements suggest a course of action to solve a given problem. A suggestion is nothing but an advice. When a person gives an advice, he thinks that there exists a situation which needs an advice and that this advice will bring in some improvement in the situation.

Example 6:

Statement:

Students are weak in English. They should be made to practice more.

Valid assumptions:

- I. Students being weak in English is not desirable.
- II. More practice would improve the performance of the students who are weak in English.

Analysis:

From the statement, it is clear that “students being weak in English” is not desirable. The author also assumes that the action suggested, would help in improving the situation. Thus, both the assumptions are valid.

Thus, **we are trying to find out the ideas that are there on the mind of the speaker based on which he makes the statement.** As discussed in the examples given above, a careful and critical analysis of the statement would lead us to the assumption on which it is based.

Summary:

- (1) Assumption is the unsaid part of a statement but is still implicit from the given statement(s).
- (2) Take help of the keywords used in the statement and assumptions. Differentiate between words which are definitive and those which are not. Comparison of key words in statement and assumptions help in answering some questions.
- (3) The assumptions in case of a notice/appeal/ advertisement are:
 - it would be read.
 - it will have some effect.
 - in case of advertisement what is mentioned therein is looked for by people.
 - in case of an appeal it is the duty of those who issued it.
 - in case of an appeal, what is mentioned therein is desirable/harmful
 - what is mentioned in notice/appeal would be followed.
 - in case of an official notice, what is mentioned therein is beneficial to the organization.

- (5) The hypothetical/unestablished subject/idea, which is being talked about in a statement, is assumed to be existing. If the absence of subject is being talked about, it is assumed that it does not exist.
- (6) In case of cause and effect kind of statements, the assumption is that the cause would lead to the effect. This kind of statements can be of the form ‘because cause, hence effect’, ‘although cause, yet no effect’ and ‘no cause, hence no effect’.
- (7) In case of a suggestion, the assumptions are
 - a situation exists which needs suggestion.
 - the situation needs to be corrected.
 - the suggestion would solve/improve the situation.
- (8) Think from the point of view of the speaker.

Let us now look at the typical directions given in examinations for these kind of questions.

Directions

In each question below, a statement is given followed by assumptions numbered I and II. An assumption is something supposed or taken for granted. You are required to assess the two assumptions and decide which of the given assumptions is/are implicit in the given statement(s) and mark your answer as

- (a) If only assumption I is implicit.
- (b) If only assumption II is implicit.
- (c) If neither I nor II is implicit.
- (d) If both the assumptions are implicit.

Let us take a few more examples and acquaint ourselves with this category of questions.

Example 7:

Statement: An unemployment allowance should be given to all those unemployed youth in India, who are above 21 years of age.

Assumptions:

- I. The government has collected enough funds through taxes to provide the unemployment allowance to the youth in India.
- II. There are unemployed youth in India who need monetary support.

🔍 **Solution:** The statement proposes to give an allowance to help the unemployed youth in India, who are above 21 years of age. Obviously, the unstated idea here is that there are indeed youth in India who are above 21 years of age, unemployed and are in need of assistance. Thus assumption II is implicit.

The statement does not give any idea regarding the availability of funds to pay the youth in case the proposal is put into effect. Hence, I is not implicit. Therefore, the answer is choice (b).

8. Statement:

Why don't you invite Ram for this year's Dussehra festival?

Assumptions:

- I. Unless invited, Ram would not attend the festival.

- II. Ram is a member of the Hindu society of Hyderabad.

👍 **Solution:** The statement is an advice given to invite Ram for the festival. The speaker has given such an advice, because he assumes that Ram will not come if he is not invited. Hence, assumption I is implicit. We cannot find any relationship between Ram's association with a society and the invitation being extended to him on that basis. Hence, assumption II is not implicit. Therefore, the answer is choice (a).

PRACTICE EXERCISE 14 (A)

Directions for questions 1 to 14: In each question below, a statement is given followed by assumptions numbered I and II. You are required to assess the two assumptions and decide which of the given assumptions is/are implicit and mark your answer as

- (1) If only assumption I is implicit.
- (2) If only assumption II is implicit.
- (3) If neither I nor II is implicit.
- (4) If both the statements are implicit.

1. Statement:

It glitters. So it is gold!

Assumptions:

- I. All that glitters is gold.
- II. Glittering things are not gold.

2. Statement:

"We produce the best footballs", claimed company X in an advertisement.

Assumptions:

- I. People would respond to such advertisements.
- II. There is demand for footballs.

3. Statement:

The Indian nuclear explosions have exposed the hypocrisy of the nuclear-haves and have filled the Indians with a sense of pride.

Assumptions:

- I. The Indians are proud people.
- II. If not for the nuclear explosions, the hypocrisy of the nuclear-haves would never have been exposed.

4. Statement:

A says to B, "Don't take black grapes. They are sour."

Assumptions:

- I. B would listen to the advice given by A.
- II. People do not prefer sour grapes.

5. Statement:

"Evaluation from the project guide who is in charge of our project is very important to grade you favourably."

Assumptions:

- I. The listeners are concerned about grades.
- II. No other criterion is necessary to decide ones grades.

6. Statement:

The prime minister is not taking any decision with regards to declaring a war against our hostile neighbour.

Assumptions:

- I. It is better if he decides the matter without any hurry.
- II. This is a matter which should be taken by the President.

7. Statement:

Every student is studying only English but not his or her mother tongue.

Assumptions:

- I. It is a good sign that everybody is studying only English.
- II. It is a bad sign that nobody is studying social sciences.

8. Statement:

Everybody loves watching Bushkashi.

Assumptions:

- I. Bushkashi is the only sport which is liked by everybody.
- II. Bushkashi is a sport.

9. Statement:

India does not want peace, therefore it is conducting nuclear tests.

Assumptions:

- I. Pakistan wants peace, therefore it is not conducting nuclear tests.
- II. Peace loving countries do not conduct nuclear tests.

10. Statement:

This can help because all good books help.

Assumptions:

- I. Books can be good and bad.
- II. All bad books do not help.

11. Statement:

The government is determined to bring in a comprehensive law to tackle the menace of communal violence.

Assumptions:

- I. So far, there is no law to tackle communal violence.
- II. Communal violence may take place in future.

12. Statement:

It is unfortunate that there have been any attempts made to define science fiction at any length or with any seriousness.

Assumptions:

- I. The existing definition of science is not acceptable.
- II. Science fiction needs to be defined.

13. Statement:

Membership should be renewed based not only on the member's contribution but also on the member's loyalty to the club.

Assumptions:

- I. Loyal members contribute more than non-loyal members.
- II. Loyalty is an important consideration while renewing membership.

14. Statement:

The sky is cloudy and the wind has stopped. It will rain soon.

Assumptions:

- I. Cloudy sky without wind leads to rain.
- II. Rain is possible when ever there is wind and the sky is cloudy.

Directions for questions 15 to 20: Select the correct alternative from the given choices.

15. Statement:

If you feel that your bones are becoming weaker day by day, take one calcium tablet everyday.

Assumptions:

- I. Calcium tablets makes the bones stronger.
- II. Irregular consumption of calcium tablet will not help.
- III. Calcium tablets would protect the bones from further weakening.

- (1) Only I and III are implicit
- (2) Only III is implicit
- (3) Only I and II are implicit
- (4) Only II and III are implicit

16. Statement:

You need solid shoes to tread the path of politics. There are many thorns on your way.

Assumptions:

- I. The path of politics is full of difficulties.
- II. Solid shoes can save one from the thorns on the path.
- III. Politicians have solid shoes.
- (1) Only I and II are implicit
- (2) Only II and III are implicit
- (3) Only II is implicit
- (4) Only I is implicit

17. Statement:

The director of the movie "Night's dream" decided to replace the female actor in the lead role, Miss Jolie Miss Rao as Miss Jolie met with an accident while shooting for her ongoing movie "The Thriller" and would not be able to shoot for the next six months.

Which of the following is an assumption implicit in the above statement?

- (1) Miss Rao does not have any other movie to be shot in the next six months.
- (2) Miss Rao is a proper replacement of Miss Jolie.
- (3) The actors should be physically fit while acting in movies.
- (4) The part of the movie "Night's dream" which involves the female actor, in leading role is going to be shot in the next six months.

18. Statement:

The school, which used to provide free breakfast to ensure that the students receive at least one proper meal a day, stopped the facility from January as the Charity Society which used to fund the breakfast withdrew the support due to drop in donations.

Which of the following is an assumption implicit in the above statement?

- (1) The students may not receive any proper meal in a day from January.
- (2) In future the donation to the Charity Society may further decrease.
- (3) The donations received by the Charity Society are used for social welfare.

- (4) The families either do not have the ability to provide proper meal to their children or ignorant of what a proper meal is.

19. Statement:

Group of commuters of the Mumbai suburban railways called for a strike in response to the increase in the number of accidents in that route in the past one year due to over crowding. The commuters want to continue the strike unless the authorities agree to increase the frequency of the trains in that route.

Which of the following is an assumption implicit in the above statement?

- (1) Increase in the frequency of the trains would lead to decrease in the number of such accidents.
- (2) The trains in the Mumbai suburban run over-crowded.

- (3) The railway authorities are indifferent to the safety of the commuters.

- (4) The railways did not increase the frequency in proportion to the increase in the number of commuters in the past one year.

20. Statement:

Now that retail shops are planning to replace plastic bags with paper bags, which are biodegradable, environmental pollution will be reduced.

Which of the following is an assumption implicit in the above statement?

- (1) Plastic bags are not biodegradable.
- (2) Biodegradable bags would not pollute the environment.
- (3) Retail shops are trying to reduce the pollutants in the environment.
- (4) Increase in the pollution is not good for the people.

PRACTICE EXERCISE 14 (B)

Directions for questions 1 to 15: In each question below, a statement is given followed by assumptions numbered I and II. You are required to assess the two assumptions and decide which of the given assumptions is/are implicit and mark your answer as

- (1) If only assumption I is implicit.
- (2) If only assumption II is implicit.
- (3) If neither I nor II is implicit.
- (4) If both the statements are implicit.

1. Statement:

These considerate coaches can also cane and cajole their players.

Assumptions:

- I. People conceiving ideas are generally not expected to cane and cajole the players.
- II. It is good if you know to cane and cajole players.

2. Statement:

To my astonishment, the lameman started walking normally when the priest touched him.

Assumptions:

- I. It looked like an organised act of cheating the observers.
- II. The priest is a doctor by profession.

3. Statement:

X is a drug which is causing ripples in the medical field.

Assumptions:

- I. No other drug is causing ripples in the medical field.
- II. X is a great drug.

4. Statement:

Many cotton farmers are committing suicide due to lack of rains.

Assumptions:

- I. Other farmers are not committing suicides.
- II. Cotton is dependent on water.

5. Statement:

A says to B, "If you want coffee, buy Nescafe."

Assumptions:

- I. B wants to buy coffee.
- II. Nescafe is a good coffee.

6. Statement:

Read this book for the exam.

Assumptions:

- I. This book is good for the exam.
- II. The person is preparing for an exam.

7. Statement:
The tickets for Balcony class are atrociously priced at ₹200.
Assumptions:
I. The tickets for other classes are decently priced.
II. ₹200 is a very big amount to pay for a balcony ticket.
8. Statement:
John does not go to church, therefore he cannot be a true Christian.
Assumptions:
I. True Christians go to church.
II. Hindus go to temple.
9. Statement:
India cannot be successful because of the democratic form of governance that it follows.
Assumptions:
I. If India changes its government, it might be successful.
II. The form of government always affects a country and shows whether it is successful or not.
10. Statement:
"Pepe Jeans, the largest selling Jeans with the largest range" - an advertisement.
Assumptions:
I. People would respond to the advertisement.
II. There is no other jeans selling as many varieties as Pepe.
11. Statement:
The protestors are demanding the dismantling of the military dominated political and business clique that has effectively ruled Algeria since independence.
Assumptions:
I. The existing rulers will improve their style of rule.
II. There are people who can rule better than the existing rulers.
12. Statement:
The boy who is about to take the exam asked his teacher, "Can I take the test more than once?"
Assumptions:
I. The first attempt may not be good enough.
II. No one can clear the test in the first attempt.
13. Statement:
Abhinav is a very successful person. He is strong and clever.
Assumptions:
I. One has to be strong and clever to be successful.
II. Successful persons are strong and clever.
14. Statement:
A good score is necessary to get a seat in the university.
Assumptions:
I. Good score alone gets a seat in the university.
II. There are other criteria to be fulfilled to get a seat in the university.
15. Statement:
Corruption has become dynamic and much more complex. Therefore, all anti-corruption institutions and organizations need to work in close tandem and coordination to tackle this menace.
Assumptions:
I. Anti-corruption institutions are not working in close coordination.
II. Complex and dynamic problems can be solved by working in close tandem and coordination.
- Directions for questions 16 to 20:** Select the correct alternative from the given choices.
16. Statement:
French luxury group Dior has launched a wrist-watch priced at ₹63 lakh which is the most expensive watch from the brand in India. Now the company is planning to launch a watch costing ₹1 crore in India.
Assumptions:
I. There are people in India who can afford a watch of cost ₹1 crore.
II. The sale of the watch costing ₹63 lakh is impressive.
III. India is growing hence the purchasing capacity of its people is growing.
(1) Only I is implicit
(2) Only II is implicit
(3) Only III is implicit
(4) Only I and II are implicit
17. Statement:
The Director of AMII, a prestigious MBA college has announced a hike of ₹1 lakh in fees, to pass on the

additional burden the institute would have to face, due to the implementation of the recommendations of the Sixth Pay Commission, besides increase in the input costs in imparting quality education.

Which of the following is an assumption implicit in the above statement?

- (1) The implementation of the recommendations of the sixth pay commission would increase the expenditure of the college
- (2) The director of a college has the authority to declare hike in fees.
- (3) The college may not be receiving any financial support from the Government to compensate the additional financial burden.
- (4) The hike in fees of ₹1 lakh per student would be sufficient to bear the additional burden and the increased input cost.

18. Statement:

Mr Vikas has decided to resign from the present job because he is selected to pursue an MBA course in JBIMS, which selects 100 best students according to the performance in written test, group discussion and interview.

Which of the following is an assumption implicit in the above statement?

- (1) JBIMS has only 100 seats in its MBA course.
- (2) Mr Vikas does not need any monetary support to pursue the MBA course.
- (3) Mr Vikas would not be able to pursue a full time MBA course while continuing with his present job.
- (4) Mr Vikas is among the 100 best students, who performed well in the written test, group discussion and interview.

19. Statement:

The Railways has decided to reduce AC and sleeper class fares by 20% in all Mail and Express trains to make it affordable for more number of people.

Which of the following is an assumption implicit in the above statement?

- (1) AC and sleeper class fares in Mail and Express train are not affordable for everyone.
- (2) The reduction in the fares of AC and sleeper class fares is not going to hamper the quality of the service provided.
- (3) The demand for the AC and sleeper class in Mail and Express trains will increase.
- (4) People like to travel by AC and sleeper class of Mail and Express trains.

20. Statement:

There is a clash in the dates of the general elections in India and the Indian Premier League Tournament (IPL). The IPL authority, considering the security of the player, shifted the tournament to South Africa, with concerns regarding the government's ability to provide security for both general elections and IPL tournament.

Which of the following is an assumption implicit in the above statement?

- (1) In South Africa, adequate security can be provided to the players.
- (2) Providing security for both IPL and the general elections is responsibility of the government.
- (3) The dates of neither the general elections nor the IPL can be changed.
- (4) Security of the players is very important for the IPL authority.

ANSWER KEYS

PRACTICE EXERCISE 14 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 4 | 3. 3 | 4. 4 | 5. 1 | 6. 3 | 7. 3 | 8. 3 | 9. 2 | 10. 3 |
| 11. 2 | 12. 2 | 13. 2 | 14. 1 | 15. 2 | 16. 1 | 17. 2 | 18. 4 | 19. 1 | 20. 2 |

PRACTICE EXERCISE 14 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 3 | 4. 2 | 5. 2 | 6. 1 | 7. 2 | 8. 1 | 9. 2 | 10. 4 |
| 11. 2 | 12. 1 | 13. 3 | 14. 3 | 15. 4 | 16. 1 | 17. 4 | 18. 3 | 19. 1 | 20. 1 |

Statements and Conclusions, Inferences

INTRODUCTION

In these questions, a statement is given followed by some conclusions. The student is required to go through the statements meticulously and then decide which of the given conclusion/s follows on its basis.

Now let us understand the basic definitions of a statement and a conclusion.

Statement → Definition

A statement is a formal account of certain facts, views, problems or situations expressed in words.

Conclusion → Definition

A conclusion is a belief or an opinion that is the result of reasoning out a given statement. It can also be defined as a proposition in an argument to which other propositions in the argument give support to.

These kind of questions are designed to test the students ability in interpreting a given statement. As such a

good grasp of the nuances of the English language and the ability to make a fine graded evaluation of the given statement would help in arriving at the proper conclusion. However, with regular practice and perseverance questions of this type can be solved with ease and accuracy.

The directions for these questions are generally as follows:

Directions: In each of the following questions, a statement is given followed by two conclusions I and II. Give answer as

- (1) If only conclusion I follows.
- (2) If only conclusion II follows.
- (3) If either I or II follows.
- (4) If Both I and II follow.

Now let us take a few examples to acquaint ourselves with this category of questions.

Solved Examples

1. Statement:

Security investments carry market risk hence it is best to consult your investment advisor or agent before investing.

Conclusions:

- I. One should not invest in securities.
- II. The investment advisor calculates market risk with certainty.

☞ **Solution:** The statement tells us that security investments are risky, hence it is advisable to consult an investment advisor. Obviously, we can conclude that the advisor is one who can predict or calculate the risk involved with certainty. Hence, conclusion II definitely follows.

I is an extreme action which suggests that one should not invest in securities, hence it does not follow. Therefore, the answer is 2.

2. Statement:

Company ABC has an envious track record in making top quality cameras with the latest innovations, which ensures that the end user gets excellent pictures even in bad weather conditions.

Conclusions:

- I. No other company has got as much recognition as ABC in this sector.
- II. Even a layman can take great photographs using the cameras made by ABC.

☞ **Solution:** The statement talks of a company ABC which manufactures top quality cameras, which perform remarkably well even in bad weather conditions.

From this, we can neither conclude that company ABC is a market leader nor that it is number one in its field. We also cannot conclude that the cameras are user friendly or that everybody could take great pictures using it. Hence, neither conclusion I nor II follow. Therefore, the answer is (1).

3. Statement:

The constitutional amendment carried out in the monsoon session of Parliament prohibits the employment of child labour in any organization.

Conclusions:

- I. All employers in India must abide by this new rule.
- II. All children below the age of 14 years will now enrol in schools.

☞ **Solution:** The statement tells us that as a result of an amendment in the constitution children cannot be employed by any organization. Since it is a constitutional amendment, it follows that all organizations should abide by it. However, from the statement we cannot deduce what these children would do once they are out of their jobs,

hence conclusion II does not follow. However, I follows, therefore (1) is the answer.

4. Statement:

The Executive Board of XYZ Ltd has asked its four regional Vice-Presidents to resign by the evening or face termination orders. Three of them have put in their papers till this afternoon.

Conclusions:

- I. The fourth manager would resign by the evening deadline.
- II. The Executive Board will terminate the service of the fourth manager as soon as the evening deadline is over.

☞ **Solution:** From the statement, it is known that by the evening the managers should resign, failing which they would be terminated. Therefore, only one of the two conclusions could possibly follow but not both. Therefore, the answer is (3).

5. Statement:

The General Manager, Operations has proposed to replace the present training programme by a new one, which would bring the true calibre of managers to the fore.

Conclusions:

- I. It is desirable to bring out the true calibre of managers.
- II. The earlier training programme was not effective in bringing out the true calibre.

☞ **Solution:** Since the GM wanted to implement a new training programme to bring out the true calibre, it means that the earlier programme had failed in this aspect. We can also surmise that, since the GM wants to bring out the true calibre of managers, it means that it must be a desirable action. Hence, both conclusions I and II follow. Therefore, the answer is (4).

Apart from the above type of questions where a statement is given followed by two conclusions, we also have questions where a statement is given followed by more than two conclusions.

Note: This model of questions do not have any special directions given for marking the answer as seen in the earlier model.

Now let us take a few examples and understand this type.

6. Statement:

"Sonali's father is thinking of giving her a wrist watch as a birthday present, so what should I give to Sonali on that day?", A is asking B for advice.

Conclusions:

- I. Sonali does not have a wrist watch.
- II. Sonali's birthday is in the near future.
- III. Both A and B know Sonali for the last three years.
- IV. A is Sonali's cousin.

- (1) Only I follows (2) Only II follows
- (3) Only III follows (4) Only IV follows

☞ **Solution:** The statement tells us that Sonali's father is planning to give Sonali a watch on her birthday. This obviously means that Sonali's birthday is in the near future but nothing is known of the relationship of A, B and Sonali. We also do not know whether Sonali already has a wrist watch or not. Hence conclusions I, III and IV are ruled out. Only II is a conclusion that follows. Choice (2) is our answer.

2. Statement:

Winter rains are supposed to be good for crops.

Conclusions:

- I. The best quality crops grow in winter rains.
- II. Rains in other seasons spoil the crops.
- III. After rains in winter, the temperature drops down.

- (1) Only I follows
- (2) Only II follows
- (3) Only I and III follows
- (4) None follows

☞ **Solution:** The statement tells us that winter rains are beneficial to the crops. It however does not tell us that rains in other seasons are detrimental to the crops, neither does it say that these rains lead to the production of best quality crops, or a record production of food grains. Hence conclusions I and II are rejected. The statement also does not tell us that the temperature falls as a result of the rains nor can we deduce it from the statement given. Hence, conclusion III also does not follow. Choice (4) is the answer.

Inference is a conclusion drawn on the basis of knowledge or facts available. In questions on INFERENCES, a paragraph is followed by few statements. On the basis of the information given in the passage, we have to check the truthfulness or falsity of the given statement. Each statement can be put into one of the three categories based on the certainty of truthfulness/falsity. The three categories are **definitely true**, **probably true** and **definitely false**. The directions provide one choice number for each of these three categories. If the statement cannot be categorised from the given information, then the answer will be "data insufficient". Let us take a set of questions and understand the five different categories as well as how to go about answering the questions.

Directions: In each question below is given a passage followed by some inferences. You have to examine each inference separately in the context of the passage and decide upon the degree of truth or falsity of the inference. Mark answer

- (1) if you think that the answer is definitely true.
- (2) if you think that the answer is probably true.
- (3) if the data provided is inadequate to answer the question.
- (4) if the answer is definitely false.

Before we start analysing the given paragraph and looking at the questions, we will first look at the choices and see what they mean.

Definitely true

We can say a statement is **definitely true** if the information given in the statement is stated explicitly in the paragraph or it follows beyond doubt from what is given in the paragraph. However, sometimes, even if it is not directly stated in the paragraph, there will be something mentioned in the paragraph which very strongly supports the information given in the question and we can conclude that what the statement mentions **has** to be true. For example,

Passage:

Mr Madan died at the age of 80, in the 50th year of his marriage.

Statement:

Mr Madan got married at the age of 30.

Analysis:

It is a simple inference that Mr Madan died at 80, after 50 years of marriage, implies that Mr Madan got married at the age of $80 - 50 = 30$ years. Thus, the given statement can be directly inferred from the passage. Hence, it is definitely true.

Sometimes, the information may not be so direct as in the following example:

Passage:

The confederation of third world countries, headed by the President of Tanzania, met the World Bank President. The World Bank President, advised the delegates that the poor countries must revamp their resources allocation preferences.

Statement:

Tanzania must revamp its resources allocation preferences.

Analysis:

The confederation of third world countries is headed by the Tanzanian President. This implies that Tanzania is a poor country. It is advised that the poor countries must revamp their resources allocation preferences. It means that Tanzania must revamp its resources allocation preferences. Hence, the given statement is definitely true.

Definitely false

We can say a statement is **definitely false** if the information given in the statement is negated explicitly in the paragraph or it follows beyond doubt, from what is given in the paragraph, that the information given in the statement is false. However, sometimes, even if what is given in the statement is not contradicted directly in the paragraph, there will be something mentioned in the paragraph, which very strongly opposes the information given in the statement. Hence, we can conclude that what the statement mentions *has* to be false. For example,

Passage:

‘Improvement of human effort in service sector provides impetus to economic progress. But better performance of service sector alone cannot guarantee economic well-being’, an eminent economist’s observation, few decades ago. This is the truth about service sector even today.

Statement:

The service sector is always bad for the growth of economy.

Analysis:

The first sentence of passage indicates that improvement in service sector would kickstart overall economic growth.

This implies that service sector is good for economic growth. Hence, the given statement is definitely false.

Data inadequate

The answer to a question is **data inadequate** when we cannot comment ANYTHING on the information/statement given in the question on the basis of what is given in the paragraph. It is possible that the paragraph DOES NOT deal even with the topic that the question states. Even if the topic is the same, what is given in the passage could be completely irrelevant to what the question states. In such cases, we cannot even say, on the basis of what is given in the paragraph, that what is given in the question is *possible* or is *not possible*.

Probably true

This choice or the next choice will be possible answers, if we are able to eliminate the above three choices for a question. The information given in the question could be pertaining to the topic that is discussed in the paragraph and has relevance to what has been discussed in the paragraph. (Hence, *data inadequate* is eliminated as a choice). However, we cannot CONCLUSIVELY say whether it is TRUE or FALSE on the basis of the information given in the paragraph but it is POSSIBLE. If the information is *more likely to be true* than to be false, then we mark the answer as **probably true**.

Example:

India’s wind power generation has leapt forward. Now, India is world’s fourth largest wind power generating country. Generous tax policies and assured power purchase agreements from the government have led to fast growth in this area. Still a lot remained unexploited.

Statement:

The government will continue with these power purchase agreements and tax benefits to this sector.

Analysis:

The passage clearly indicates that it is the generous tax policies and power purchase agreements that encouraged growth in wind power generation. It is also mentioned that there is lot of scope for growth in this area. Keeping all the above in view, it is more likely that the government would continue with these policies. Hence, the statement is probably true.

Differentiating between ‘Definitely True’ and ‘Probably True’

Sometimes, the information given in the statement can be inferred easily from the statement as it is directly or

explicitly available in the passage. Sometimes, it may not be possible to infer directly from the passage but if it appears to be true, you may have to make some assumptions. In such instances we get a doubt, whether to take it as definitely true or probably true. If the assumption made is 'universally true' or 'it can never be false', then the statement is definitely true, otherwise it is probably true.

Example:

State 'X', with highest number of accidents, has poorly lit roads, whereas state 'Y', with least number of accidents, has all its roads properly illuminated.

Statement:

In state 'X', most of the accidents are owing to poor lighting of roads.

Analysis:

The passage does not provide any direct relationship between the number of accidents and illumination of roads. But, on comparing the situations existing in state X and Y, it appears that the information provided in the statement is **probably true**.

Differentiating between 'Data Inadequate' and 'Probably True'

A confusion arises when an inference is not drawn directly from the given passage. Since it is not explicitly mentioned, you think that the data are inadequate and that sufficient information is not given in the passage to come to a conclusion. However, the inference appears to you in tune with the general tone of the passage, hence you are tempted to choose probably true.

If the inference is likely to be true with the assumption made, then the answer is probably true. If no conclusion can be drawn even after making assumption, then the answer is "Data Insufficient".

Key Words

Sometimes key words help in evaluating the inferences. Some examples of key words are - all, some, none, always, never, sometimes, must be, may be, will be, had to, nevertheless, despite, inspite of, because of, etc.

Example:

Jadav is finally selected to play for Indian Hockey team. All the players of hockey team are asked to wear uniform.

Statement:

Jadav has to wear uniform.

Analysis:

The word 'all' includes Jadav also. Hence, the statement is definitely true. If words like 'most', 'few', 'many', etc., are used, then the answer changes.

Example:

UNICEF: Established in 1946, is the only distinctive inter-governmental organization concerned with children's welfare. Supported entirely by voluntary contributions from governments and individuals, UNICEF helps children all over the world. It is governed by a 30-nation executive board designated by the Economic and Social Council.

Statement:

1. Apart from the UNICEF, there are no other agencies concerned about children's welfare.

☞ **Solution:** It is mentioned in the paragraph that UNICEF is the only 'inter-governmental' agency concerned with children's welfare which means that there are other agencies, with different constitution, as well. Hence, this statement is *definitely false*. Choice (4). [It may appear that since we cannot conclude whether there are other agencies or not, the answer choice is *probably false*. However, had this been the idea that is intended in the paragraph, then the statement in the given paragraph would have read like "It is *a* distinctive inter-governmental" Also, the word *distinctive* means there *must* be some other organizations (with which it can be compared).]

Statement:

2. UNICEF is a sub-organization of the United Nations Organization.

☞ **Solution:** There is no information in the passage as to how UNICEF is related to UNO.

Statement:

3. The letter C in UNICEF stands for "children".

☞ **Solution:** Since UNICEF is concerned with children, it is very likely that its full form should have "children" somewhere in its name. In the abbreviated form, there is only one letter C and this can be expected to stand for "children". We can say that the given statement is more likely to be true i.e., **probably true** and, hence, the answer choice is (2).

Statement:

4. The UNICEF has been very successful.

☞ **Solution:** Since it was started in 1946 and is still running and there has been no mention or indication

of the organization not being able to meet its objectives, this would be most **probably true**. Hence, the correct choice is (2).

Statement:

5. The UNICEF has been expanding rapidly in the recent past.

👍 **Solution:** Nothing can be said in this regard because there is no information on the expansion plans of UNICEF. Hence, choice (3).

Summary:

1. Check whether the inference can be directly evaluated from the passage.
2. If an inference cannot be directly evaluated check if it can be evaluated with the help of universally accepted facts/ideas.
3. The inferences can be evaluated based on key words.
4. To avoid confusion between 'definitely true' and 'probably true', check whether the information used is explicitly mentioned in the passage or not. If not, though there is no direct evidence, check whether it is likely to be true.
5. To avoid confusion between 'probably true' and 'data inadequate', check if it is possible to make reasonable assumption to make the statement 'probably true'.

PRACTICE EXERCISE 15 (A)

Directions for questions 1 to 12: In each question below is given a statement followed by two conclusions numbered I and II. You have to assume everything in the statement to be true, then consider the two conclusions together and decide which of them logically follows beyond reasonable doubt from the information given in the statement. Give your answer as:

- (1) if only conclusion I follows.
- (2) if only conclusion II follows.
- (3) if neither I nor II follows.
- (4) if both I and II follow

1. Statement:

Whenever there are special events or celebrations, magazines publish special supplements covering the occasion; readers must reserve their copies of such supplements much in advance.

Conclusions:

- I. Special supplements give very good coverage to the event concerned.
- II. These special supplements are very much in demand.

2. Statement:

In a certain area, 40% of women are in government service whereas 70% of the population of that area is in government service.

Conclusions:

- I. 60% women have jobs in private undertakings.
- II. 40% couples are in government service.

3. Statement:

The Vedas are packed with the greatest wisdom; a German scholar, Max Muller published the first scholarly translation of the Vedas.

Conclusions:

- I. Germans discovered wisdom.
- II. The Vedas are written in German.

4. Statement:

India has quite a number of Indo-German collaborations, hence our projects are getting technical as well as financial aids.

Conclusions:

- I. Collaborations are formed to help each other in every field.

- II. Some collaborations lead to the dissemination of technical know-how.

5. Statement:

Many great scientists are conducting research work on outer space.

Conclusions:

- I. Only the space has mysteries and surprises.
- II. Outer space offers a challenge to scientists.

6. Statement:

This world is neither good nor evil but each man interprets the world in his own way.

Conclusions:

- I. Some people find this world quite good.
- II. Some people find this world quite bad.

7. Statement:

The government of Country 'X' has recently announced several concessions and offered attractive package tours for foreign visitors.

Conclusions:

- I. Now, more numbers of foreign tourists will visit the Country 'X'.
- II. The Government of Country 'X' seems to be serious in attracting foreign tourists.

8. Statement:

A 14 year old school boy was found to be the main culprit behind the recent bank robbery. When he was prosecuted he said that he was inspired by movies on the 'Star movies', a channel beamed by the local Cable T.V. network and this is the latest incident that supports the cause and effect theory under examination.

Conclusions:

- I. Movies have a great impact on some young minds.
- II. Young minds are adventurous.

9. Statement:

Out of the five hundred students graduating from the IITs this year, only three hundred were recruited by foreign companies and have gone to work abroad.

Conclusions:

- I. Some of the remaining two hundred graduates are working in India.
- II. All the remaining two hundred graduates are working abroad.

10. Statement:

Rebel leaders have their own secret stock of arms and ammunition as they often have clashes with the police.

Conclusions:

- I. The police too suffer casualties during such encounters.
- II. The rebels have their own sources of getting these supplies.

11. Statement:

Rabies is a disease transmitted to men and animals through the bite of a rabies-infected animal, most commonly being dogs.

Conclusions:

- I. Rabies is a communicable disease.
- II. One should not irritate dogs.

12. Statement:

As a leading academic destination Australia is a mecca of academic excellence, renowned for quality studies and unmatched educational facilities.

Conclusions:

- I. Other than Australia no other country in the world can give the best academic education.
- II. Apart from education Australia is not the best in any other field.

Directions for questions 13 to 15: Select the correct alternative from the given choices.

13. Statement:

The director of the movie "Night's dream" decided to replace the female actor in the lead role, Miss Jolie with Miss Rao as Miss Jolie met with an accident while shooting for her ongoing movie "The Thriller" and would not be able to shoot for the next six months.

Which of the following can be an **inference** that can be drawn from the above statement?

- (1) Miss Rao does not have any other movie to be shot in the next six months.
- (2) Miss Rao is a proper replacement of Miss Jolie.

- (3) The actors should be physically fit while acting in movies.
- (4) The part of the movie "Night's dream" which involves the female actor, in leading role is going to be shot in the next six months.

14. Statement:

The Director of AMII, a prestigious MBA college has announced a hike of ₹1 lakh in fees, to pass on the additional burden the institute would have to face, due to the implementation of the recommendations of the Sixth Pay Commission, besides increase in the input costs in imparting quality education.

Which of the following can be **inferred** from the above statement?

- (1) The implementation of the recommendations of the Sixth Pay Commission would increase the expenditure of the college.
- (2) The director of a college has the authority to declare hike in fees.
- (3) The college may not be receiving any financial support from the Government to compensate the additional financial burden.
- (4) The hike in fees of ₹1 lakh per student would be sufficient to bear the additional burden and the increased input cost.

15. Statement:

Mr Vikas has decided to resign from the present job because he is selected to pursue an MBA course in JBIMS, which selects 100 best students according to the performance in written test, group discussion and interview.

Which of the following can be **inferred** from the above statement?

- (1) JBIMS has only 100 seats in its MBA course.
- (2) Mr Vikas does not need any monetary support to pursue the MBA course.
- (3) Mr Vikas would not be able to pursue a full time MBA course while continuing with his present job.
- (4) Mr Vikas is among the 100 best students, who performed well in the written test, group discussion and interview.

Directions for questions 16 to 20: Given below are some passages, each passage followed by several possible inferences that can be drawn from the facts stated in the passage. You have to examine each inference separately in the context of the passage and decide upon its degree of truth or falsity. Mark your answer

- (1) if the inference is “definitely true”, i.e.; it properly follows from the statement of facts given.
- (2) if the inference is “probably true”, though not “definitely true”, in the light of the facts given.
- (3) if the data is inadequate, i.e., from the facts given you cannot say whether the inference is likely to be true or false.
- (4) if the inference is “definitely false”, i.e., it cannot possibly be drawn from the facts given or it contradicts the given facts.

In its World Development Report for 2004 titled ‘Making Services. Work for the Poor People’ the World Bank has stated that a high degree of involvement of the poor in determining the quality and quantity of services they receive such as health, education, water, sanitation, energy and transport is the key to success. In support of this, the Bank has quoted the success story of Madhya Pradesh where community involvement in recruiting teachers, getting schools built and encouraging neighbours to enrol their children, played a crucial role. In its comparative study, the chapter titled “Spotlight on Kerala and UP”, the report highlights the Human Development contrast between Kerala and UP, which according to it, is due to the fact that the former spends one-third of its money on health and education and the latter spends three-fourth

of its money on state administration. As a result, infant mortality rate in UP is five-times higher than that of Kerala, one third of the girls had never been to school while Kerala enjoys universal enrolment, Kerala’s fertility rate at 1.96 births per woman is comparable to that of USA (2.1) and higher income European nations (1.7), while UP has a fertility rate of 3.99, higher than the national average of 2.85 and 3.1 in low income countries. Moreover, Keralite women enjoy 20 years longer life span than their counterparts in UP.

16. The World Bank is convinced about the ability of the poor to assess the services received by them.
17. In Madhya Pradesh, the community involvement in educational field was more than that in any other state.
18. The amount of money spent by Kerala on health and education is more than the amount spent by UP on the same.
19. High infant mortality rate in a state is a result of low literacy rate in that state.
20. Women who enjoy a longer life span must belong to a state with the highest fertility rate.

PRACTICE EXERCISE 15 (B)

Directions for questions 1 to 12: In each question below is given a statement followed by two conclusions numbered I and II. You have to assume everything in the statement to be true, then consider the two conclusions together and decide which of them logically follows beyond reasonable doubt from the information given in the statement. Give your answer as:

- (1) if only conclusion I follows.
- (2) if only conclusion II follows.
- (3) if neither I nor II follows.
- (4) if both I and II follow.

1. Statement:

The pigeon was one of the agents of mail in the past; still in some parts of Orissa pigeon mail is used by the Police department.

Conclusions:

- I. The Department of Post and Telegraph has not made any progress in the last century.

II. The Police must be finding the pigeons more convenient as compared to the other sources of Postal delivery.

2. Statement:

USA is helping Pakistan to build up a massive military.

Conclusions:

- I. USA wants Pakistan to attack India.
- II. Pakistan’s intention is to attack India.

3. Statement:

Eighty per cent of the employees of X Ltd, earn more than Rupees 5,000 per month. Seventy per cent of employees of X Ltd work as supervisors.

Conclusions:

- I. All the supervisors earn more than Rupees 5,000 per month.
- II. Less than 100% of the supervisor earns more than Rupees 5,000 per month.

4. Statement:

Many big time cinema producers are becoming TV serial producers these days.

Conclusions:

- I. TV Serials are not risky.
- II. Movie making is very expensive.

5. Statement:

All patients with high blood pressure were found to be having some worry or the other.

Conclusions:

- I. Mental tensions may affect blood pressure.
- II. If one has no mental tensions one may not suffer from high blood pressure.

6. Statement:

All the black-marketeers of foreign currencies are seen near the port whenever a new ship arrives. Mr A, one such marketer, is near the port.

Conclusions:

- I. A new ship has arrived.
- II. Mr A has foreign currency.

7. Statement:

A top Hollywood actor of Indian origin has given up his profession there and has come back to act in Indian films.

Conclusions:

- I. Love of the motherland and a desire to work for his Country made him come back to India.
- II. He was facing some problem in the Hollywood film industry.

8. Statement:

The standard of education in private schools is much better than that in Municipal and Zilla Parishad schools.

Conclusions:

- I. All Municipal and Zilla Parishad schools should be closed immediately.
- II. Now onwards Municipal and Zilla Parishad schools must make efforts to improve the standard of their schools.

9. Statement:

The Indian government has announced many self-employment schemes to mitigate the plight of unemployed youth.

Conclusions:

- I. Unemployment plagues India.
- II. Government cannot provide everybody a job.

10. Statement:

The Prime Minister emphatically stated that his government will make every possible effort for the upliftment of poor farmers and farmhands.

Conclusions:

- I. Except poor farmers and farmhands, all others have got the benefits of the fruits of development.
- II. No serious efforts have been made in the past for the upliftment of poor farmers and farmhands.

11. Statement:

Poise, composure, courage, persuasion, extreme patience and tact constitute the base on which leadership can grow.

Conclusions:

- I. Cowards cannot become leaders.
- II. A monk who has extreme patience can be proved the best leader.

12. Statement:

Accidents on road can be prevented provided the quality of roads is improved and the drivers are instructed in adhering to safety rules which they must follow for their own protection.

Conclusions:

- I. Damaged roads may cause accidents.
- II. Reckless driving may cause accidents.

Directions for questions 13 to 15: Select the correct alternative from the given choices.

13. Statement:

Group of commuters of the Mumbai suburban railways called for a strike in response to the increase in the number of accidents in that route in the past one year due to over crowding. The commuters want to continue the strike unless the authority agrees to increase the frequency of the trains in that route.

Which of the following can be **inferred** from the above statement?

- (1) Increase in the frequency of the trains would lead to decrease in the number of such accidents.
- (2) The trains in the Mumbai suburban run overcrowded.
- (3) The railway authorities are indifferent to the safety of the commuters.
- (4) The railways did not increase the frequency in proportion to the increase in the number of commuters in the past one year.

14. Statement:

The school, which used to provide free breakfast to ensure that the students receive at least one proper

meal a day, stopped the facility from January as the Charity Society which used to fund the breakfast withdrew the support due to drop in donations. Which of the following can be **inferred** from the above statement?

- (1) The students may not receive any proper meal in a day from January.
- (2) In future, the donation to the Charity Society may further decrease.
- (3) The donations received by the Charity Society are used for social welfare.
- (4) None of these

15. Statement:

The Railways has decided to reduce AC and sleeper class fares by 20% in all Mail and Express trains to make it affordable for more number of people.

Which of the following can be **inferred** from the above statement?

- (1) AC and sleeper class fares in Mail and Express train are not affordable to everyone.
- (2) The reduction in the fares of AC and sleeper class fares is not going to hamper the quality of the service provided.
- (3) The demand for AC and sleeper class in Mail and Express trains will increase.
- (4) People like to travel by AC and sleeper class of Mail and Express trains.

Directions for questions 16 to 20: Given below are some passages, each passage followed by several possible inferences that can be drawn from the facts stated in the passage. You have to examine each inference separately in the context of the passage and decide upon its degree of truth or falsity. Mark your answer

- (1) if the inference is “definitely true”, i.e., it properly follows from the statement of facts given.
- (2) if the inference is “probably true”, though not “definitely true”, in the light of the facts given.

- (3) if the data is inadequate, i.e. from the facts given you cannot say whether the inference is likely to be true or false.
- (4) if the inference is “definitely false”, i.e., it cannot possibly be drawn from the facts given or it contradicts the given facts.

Once through, you will know why your dad and mom bought it for you in the first place, because it is a Diwali-kind of book, one that teaches you the good from bad. Sprinkled liberally with morals, it should help you in the exciting life that lies ahead of you. Quite like the value education classes in school, if they still have them.

The author and social worker Sudha Murthy is a computer science teacher who does not have to look far to solve the problems that crop up in her life. She just dips into her large treasure chest of Indian mythology, most of which she picked up in the laps of her grand parents when she was a little girl. If old tales and legends do not help, she falls back on the lessons learnt from her mother and father, her favourite teacher Govamma and the students she has taught over the years.

Have a window sill to curl up on, kids? No? Then take a favourite chair, or better still, throw yourself and, before you plonk down, grab ‘How I Taught My Grandmother to Read’.

16. ‘How I Taught My Grandmother to Read’ is based on real life problems of the author.
17. The best place to sit and read a story book for kids is a window sill.
18. Diwali teaches you to differentiate the good from the bad.
19. The author of the book has a large library of Indian mythological books.
20. The author of the book does not have problems to solve in her life.

ANSWER KEYS

PRACTICE EXERCISE 15 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 3 | 4. 2 | 5. 2 | 6. 4 | 7. 2 | 8. 1 | 9. 3 | 10. 2 |
| 11. 1 | 12. 3 | 13. 3 | 14. 3 | 15. 1 | 16. 1 | 17. 2 | 18. 3 | 19. 4 | 20. 4 |

PRACTICE EXERCISE 15 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 3 | 4. 3 | 5. 4 | 6. 3 | 7. 3 | 8. 3 | 9. 2 | 10. 3 |
| 11. 1 | 12. 4 | 13. 4 | 14. 4 | 15. 3 | 16. 3 | 17. 1 | 18. 1 | 19. 3 | 20. 4 |

Courses of Action

INTRODUCTION

In this category of questions, a statement delineating a problem is given followed by certain other statements, which could be solutions to the problem identified in the main statement. Out of these, the student has to identify those statements which are practical and feasible solutions to the problem and pick them as possible courses of action to be followed.

Definitions

Statement:

A formal account of facts, views, problems or situations expressed in words.

Courses of Action:

A practical and feasible action, administrative or otherwise, which solves a problem or alleviates a given condition or improves the situation.

These questions require:

- (1) A clear and unbiased understanding of the given statement.
- (2) Identification of the problem within the statement.

Only when these two things are done will the student be in a position to actually think of a possible solution to the problem and with this idea in mind he will pick up a choice that matches it.

Technique to answer the question:

Problem - Solution

We accept a course of action,

- (I) if it solves the problem contained in the statement.
- (II) if it is practical.

Effectiveness of a Course of Action

A suggested course of action can be accepted if it is an accepted fact or an indication from past experience or a logical measure. Let us discuss each of these in detail.

- (1) **If the suggested course of action is an established fact.**

Here, we have to make use of our common knowledge of worldly realities and facts.

Let us understand this with the following example:

Statement:

Water-borne diseases are rampant.

Course of action:

Drink boiled water.

Analysis:

It is an established fact that boiled water protects against water-borne diseases. As drinking boiled water is a measure to prevent health hazards, this is an apt course of action.

(2) If the suggested course of action is an indication based on past experiences.

Here, the suggested course of action is an aftermath of previous incidences, based on something which has happened in the past - again concerning our awareness regarding various activities.

For example:

Statement: "Despite several laws, child labour is continuing unabated." A survey report in 2003.

Course of action:

Pass another law to curtail child labour.

Analysis: From the statement, it is evident that we already have laws to curtail child labour. Our experience indicates that failure in enforcement of laws and ignorance of the people are the reasons for persistence of this social problem. Hence, basing on our past experience, such a course of action is not a valid one.

(3) If the suggested course of action logically follows:

In certain cases, it is logic that leads to a decision, as shown in the following example.

Statement:

Mr X wants to buy a car owned by Mr Y.

Course of action:

Mr X should get the car inspected by an experienced mechanic before making the deal.

Analysis:

Mr X is purchasing a car from Mr Y. It implies that he is buying a second hand car. It is logical that while buying a second hand car, one should know the condition of the car, which can be best verified by an experienced mechanic only. Thus, the suggested course of action logically follows the given statement.

Practicality of the Suggestion

Certain suggestions may not be practical for implementation, though they may appear logical. Similarly, certain suggested courses of action, though they may solve the problem, can still result in a new problem. Such suggestions should not be accepted.

The suggested course of action should be properly matched to the magnitude of the given problem. The suggestion should neither be like 'killing a mosquito with a knife' nor 'killing an elephant with a needle'.

It may be suggested that people should be asked not to shout in order to increase their life expectancy, because shouting leads to noise pollution, which further leads to stress, thus reducing the life expectancy. Of course, shouting may lead to noise pollution, but it is only a minor component contributing to noise pollution.

Let us understand this better with the help of the following example.

Example:

Statement:

Government is unable to eliminate tax evasion.

Course of action:

Abolish all taxes.

Analysis:

Logically, when there is no tax, question of tax evasion does not arise. But this leads to new problem. Government will not have any revenue to take up developmental activity. Thus such a suggestion should not be accepted as it leads to a new problem.

Fact-follow-up Action

So far we have discussed a "problem-solution" pattern of question. Certain statements merely give facts. The suggested course of action offers a measure to improve the situation.

We follow the methods discussed above for "fact-follow-up action" kind of questions as well.

Initially, we check whether the suggested course of action would induce improvement in the situation or reduce intensity of the problem. Then we check whether that suggestion is practical or not.

The following points are also to be kept in mind while validating the suggested courses of action.

Points to Remember

- A. A negative course of action should not be taken.
- B. The given solution should be practical.
- C. A solution which brings in benefits or solves the problem after an inordinate delay should be avoided.
- D. The course of action should pertain directly to the problem.
- E. The course of action proposed should independently be able to solve a problem and it should not be contingent to some other 'to' conditions being met.
- F. It should not result in another problem.

Now let us discuss the above points with the help of an example.

Statement:

'X' area has extremely fertile soil. But the farmers of this area are in distress and in debts, as their crops have been failing for the last 3 years, as a result of inadequate rainfall. Some of the farmers have even gone to the extent of committing suicide.

Courses of Action

1. The farmers should be asked to migrate to an area with sufficient rainfall.
2. Water should be brought in tankers from the nearby river to irrigate the farms.
3. A proposal should be submitted to the government to build a dam on the nearby river and to construct irrigation canals to irrigate area 'X'. This would take at least 12 years for completion.
4. Afforestation should be taken up on top-most priority in the neighbouring state, which could improve rainfall.
5. A channel, linking the river to the area 'X', be built immediately, subject to the clearance from the State and the Central governments as also from environmental agencies.
6. Farmers should sell their lands to clear their debts.
7. Government should impose moratorium on a recovery of loans from farmers and provide assistance to farmers to grow arid crops.

Let us analyse each of the suggested courses of action one by one.

☺ **Solution:**

1. This is not the right course of action, as it is a negative approach. (Point A)
2. This could solve the problem. However, the idea suggested is impractical and very costly to implement. (Point B)
3. This is a measure that would provide a long term solution but its benefits would accrue only after a very long delay. Hence, it is not a feasible solution as the immediate problem is not redressed. (Point C)

4. There is no link to show that afforestation in the neighbouring state would improve the rainfall in area X and as such this does not directly redress the problem. (Point D)
5. This proposes building a channel immediately, which would connect the river and the area X, which would solve the problem. However, this proposal requires clearance from environmental agencies and two government bodies which generally takes a lot of time. Hence, this is not a proper course of action. (Point E)
6. Logically it may appear to be a solution, but the farmers will become landless and this course of action will add more troubles for them. As this suggestion creates a new problem, i.e., it is invalid. (Point F)
7. This is a positive suggestion. Moratorium on loan recovery gives time to farmers to stabilize. Growing arid crops is a logical solution for unirrigated lands. Hence, it is a valid course of action.

Directions: The typical directions for these questions are as follows:

In each question below, a statement is given followed by two conclusions numbered I and II. You have to take the statement to be true. Read both the conclusions and decide which of the two or both follow from the given statement.

Mark your answer as

- (1) If only conclusion I follows.
- (2) If only conclusion II follows.
- (3) If neither I nor II follows.
- (4) If both conclusions I and II follow.

Now let us take a few examples and understand the methodology involved in solving these kind of questions.

Solved Examples

1. Statement:

Children nowadays prefer watching TV programmes, meant for adults, to studying in the evenings.

Courses of action:

- I. Parents should switch off TV sets during their child's study hours.
- II. Children who insist on watching these type of programmes should be whipped.

☺ **Solution:** The statement outlines the basic problem of children forsaking study time and wasting it in watching programmes meant for adults. Obviously, any action which makes the students study, without wasting time on worthless pursuits, would be welcome.

- I. is a practical course of action and solves the problem. Hence, it follows.
- II is an extreme action, hence it does not follow. Therefore, choice (1) is the answer.

2. Statement:

Most of the pavements are crowded with the display of various articles, sold by hawkers at cheap rate, thus causing traffic congestion.

Courses of action:

- I. Passersby buying such articles on the road should be prosecuted.
- II. The local authorities should try and provide a market place for these hawkers so that they too can earn their living without causing inconvenience.

☺ **Solution:** The problem given in the statement is the blockage of traffic, caused by the hawkers who occupy the footpaths to display their wares. The problem can be set right if the root cause is identified and it is eliminated. The root cause here is that hawkers do not have a market place or substitute to reach their customers other than attracting the passersby walking on the pavement. This can be eradicated by providing the hawkers an alternate place to peddle their wares, as proposed by II, hence it follows. I is an extreme action on account of the word 'prosecuted', hence it is rejected. Therefore, choice (2) is the answer.

3. Statement:

As per a survey conducted by the Ministry of Tourism, it has been found that leading hotels in the country have incurred a cumulative loss of 175 crores as a result of a sharp drop in tourist inflows on account of the tension prevailing in Kashmir and the related terrorist activities.

Courses of action:

- I. The government should provide financial assistance to the tourism industry.
- II. The government should inform all the tourists who intend to travel to India, to safeguard themselves.

☺ **Solution:** The problem given here is that of a drop in the volume of tourists visiting India and the resulting losses to hotels. The government compensating the hotel industry is not a valid course of action as the issue of increasing tourism is not redressed. In II, the government is shrugging off the responsibility of safeguarding the tourists, which will have a negative effect on tourism. Hence, both do not follow. Therefore, choice (3) is the answer.

4. Statement:

A major rail accident, involving a passenger train, was averted by the prompt action of a wayside signalman, who, on noticing two trains on the same track, promptly diverted one of the trains to the other track.

Courses of action:

- I. The latest technology in automatic signalling, using a network of computers, should be adopted to eliminate maximum errors from the system.
- II. The alert signalman should be rewarded to encourage this trait among other employees.

☺ **Solution:** The statement tells us how the promptness of the alert signalman averted a tragedy. When we have two trains coming from the opposite directions on the same track it means that the signalling system has failed at some point or the other. Enquiring into what caused such a mix up and taking remedial measures are the usual steps taken by authorities in such cases. Installing automatic signalling using computers can be one of such measures, which would eliminate occurrence of errors. The alert signalman, who has done such a sterling deed, should be rewarded to encourage this trait. Hence, both I and II are possible courses of action to be adopted. Therefore, choice (4) is the answer.

PRACTICE EXERCISE 16 (A)

Directions for questions 1 to 10: In each question below, a statement is given followed by two courses of action, numbered I and II. A course of action is a step or administrative decision to be taken for improvement, follow-up or further action in regard to the problem, policy etc., on the basis of the information given in the statement. You have to consider everything in the statement to be true, then decide which of the two suggested courses of action logically follow(s) for pursuing. Mark your answer as

- (1) if only I follows.
- (2) if only II follows.
- (3) if neither I nor II follows.
- (4) if both I and II follow.

1. Statement:

The Indian cricket team reached the finals of the previous six major tournaments, but failed to win even a single tournament.

Courses of Action:

- (I) The Indian cricket board should set up a committee to find out the reasons.
- (II) The team should change its game plan.

2. Statement:

In the road accidents, the pillion riders are receiving more head injuries than the driver.

Courses of Action:

- (I) Pillion riders should also wear helmet.
- (II) The rule should be changed so that the helmet is made compulsory for the pillion riders but not the drivers.

3. Statement:

Now-a-days, the number of suicide cases is increasing.

Courses of Action:

- (I) We should change our education system, where the people can learn the basic values of life.
- (II) Mostly the suicides are seen in youngsters due to stress. The lifestyle, which the youngsters experiencing, is the cause. There is no solution for it.

4. Statement:

The Government is worried by the sudden collapse of a bridge, which is under construction, which lead to death of 16 people and injuries to many.

Courses of Action:

- (I) The government should set up an inquiry committee to investigate the reasons for collapse.
- (II) The authorities should shift the injured people to the hospital and clear the debris to see if someone is trapped.

5. Statement:

Two thirds or even more of the world's polar bears will disappear by 2050 due to shrinking summer sea ice, even under moderate projections caused by greenhouse gases in the atmosphere.

Courses of Action:

- (I) We should control environmental pollution by reducing the emission of greenhouse gases and make people aware of effects of greenhouse gases through media.
- (II) Shift the polar bears to the other parts of the world, like Antarctica, where thick layer of ice is available.

6. Statement: Over 100 villagers have died in Gujarat last month due to consumption of illicit liquor.

Courses of Action:

- I. The traffickers of illicit liquor should be arrested.
- II. The government should ban sale of liquor.

7. Statement: The shares of Satyam have shown a steep fall after the confession of its CEO, Ramalinga Raju, that he had given inflated figures of the profits of the company.

Courses of Action:

- I. The CEO of Satyam should be interrogated to know the truth of the matter.
- II. The government should introduce more stringent norms to audit the firms.

8. Statement: The Indian pharma companies are worried that a bill tabled in the US House threatens to jeopardise their plans to launch Biotech Genesis in America.

Courses of Action:

- I. The pharma companies should try to convince the introducer of the bill, Sasha Rodgers, to withdraw it.

- II. The pharma companies should look for alternate markets if the bill imposes longer exclusivity periods on these pharma companies.

9. Statement: Sashank has to attend an interview in Hyderabad next week. The MET department has predicted heavy rains in Hyderabad throughout the next week.

Courses of Action:

- I. Sashank should reschedule his interview, to avoid the rains.
II. Sashank should cancel the interview.

10. Statement: Global warming poses an immense threat to our survival. The global temperatures are increasing and floods, droughts, forest fires are the results of climate change which are common these days.

Courses of Action:

- I. All countries should take initiatives to invest in green technologies.
II. United Nations should implement emission norms.

Directions for questions 11 to 18: In each question below, a statement is given followed by three courses of action numbered I, II and III. A course of action is a step or administrative decision to be taken for improvement, follow-up or further action in regard to the problem, policy etc., on the basis of the information given in the statement. You have to consider everything in the statement to be true, then decide which of the three suggested courses of action logically follows for pursuing.

11. Statement

Every year Malaria gets rampant after the rains.

Courses of Action:

- I. Pesticides should be sprayed properly on regular basis.
II. People should be supplied with mosquito nets and mosquito coils free by the Government.
III. Using various means of media, people should be informed about the methods to be adopted for prevention from these seasonal diseases.
(1) Only I and III follow (2) Only II and III follow
(3) Only II follows (4) Only I and II follow

12. Statement:

Students attendance in regular colleges is falling day by day, while in private coaching centres the situation is just the opposite.

Courses of Action:

- I. Students must be given individual attention.
II. At least once in a week they must be given a test.
III. Without proper attendance, a student must not be allowed to attend the final examinations.
(1) Only II follows (2) I and III follow
(3) Only III follows (4) None follows

13. Statement:

Devotees in the pilgrimage are much disturbed by the loud noise made by the loud speakers and tape records played in the premises of temple streets.

Courses of Action:

- I. The devotees should be provided with ear plugs.
II. All those, who make noise by using any of the means, should be strictly warned by the government to adhere to the permissible sound levels, or else face punishment.
III. Selling and buying must be prohibited in pilgrimage premises.
(1) Only I follows
(2) Only II follows
(3) Only II and III follow
(4) Only III follows

14. Statement:

Our neighbouring country is manufacturing nuclear weapons. It's a threat to our country.

Courses of Action:

- I. We should disclose what arms we have so that the neighbouring country will be deterred.
II. We should conduct a series of nuclear tests.
III. We should be alert by all means.
(1) Only I and II follow
(2) Only III follows
(3) Only II follows
(4) All the three follow

15. Statement:

Residents from Model Colony coming under the north-ward of city 'X' have complained to the ward officer that for the last three days the tap water in the ward has been contaminated and no action has been initiated by the municipal staff.

Courses of Action:

- I. The ward officer of the north-ward should initiate an action against residents who have lodged complaints against the municipal staff.

- II. The ward officer should ask the ward engineer to check water installations and get samples of water tested from laboratories.
- III. People belonging to the north-ward of the city should go for their own borewells.

- (1) Only I. follows
 (2) Only II. follows
 (3) Only II and III. follow
 (4) None follows

16. Statement:

The non-performing assets in the banking sector in India stand at a staggering ₹80,574 crores for the year ending 2001. The biggest defaulters in paying up the loans to the banks are the major players in the Indian corporate sector. If this trend continues, the banking sector would be severely hit.

Courses of Action:

- I. The banks should stop lending money to the corporate sector.
- II. The banking sector should, henceforth, exercise extreme prudence while sanctioning loans.
- III. All efforts, including legal recourse, should be made to recover the outstanding loans.
- (1) Only I follows
 (2) Both I and II follow
 (3) Both II and III follow
 (4) Only III follows

17. Statement:

In India, unexpected deaths in road accidents as a result of lack of emergency medical facilities, is increasing by the day. At last count 80,000 people died in road accidents last year, which accounts one death every 6 minutes.

Courses of Action:

- I. Ambulances equipped with the latest technology and accompanying medical crew must be available round the clock at all hospitals to reach the victims on time.
- II. Facilities in hospitals should be expanded to treat road accident victims.
- III. 'Flying hospitals' on wheels must be used to patrol the streets regularly.
- (1) Both I and II follow
 (2) Only I follows
 (3) Only II follows
 (4) All follow

18. Statement:

Poor umpiring decisions have come close to ruining the charm of cricket. Not only do bad umpiring decisions influence the outcome of a game but it can also ruin a player's career.

Courses of Action:

- I. Umpires of high standing and repute only should be allowed to officiate.
- II. All decisions should be made on the basis of TV replays and associated technology to avoid human error.
- III. All matches where such poor decisions have altered the course of a game should be replayed.
- (1) Only I follows (2) Only II follows
 (3) Both I and III follow (4) Both I and II follow

Directions for questions 19 and 20: Select the correct alternative from the given choices.

- 19.** Now-a-days, many sky scrapers are coming up, leaving no place for children to play. The children are forced to play on the roads, sometimes causing accidents. Some parents do not allow their children to play, leading to lack of physical exercise.

Which of the following would be the most appropriate course of action to solve the problem?

- (1) Parents should set up a gym in the house for the physical exercise of the children.
 (2) The authorities should not allow building of skyscrapers so that the children will get a playground at convenient distances.
 (3) Children should play in school playgrounds.
 (4) None of these.

- 20.** Software companies are setting up their offices in the city. Many people from various states are coming to the city for the job. As the number of people in the city is increasing at a rapid pace, the people are facing problems in finding residential dwellings. The rentals have doubled in one year in the city, despite having rent control acts. Very few houses or hostels are available at affordable rents.

Which of the following would be the most appropriate course of action to solve the problem?

- (1) Do not allow the software companies to enter the city.
 (2) The authorities should enact one more rent control act.
 (3) Authorities should build new buildings.
 (4) None of these

PRACTICE EXERCISE 16 (B)

Directions for questions 1 to 10: In each question given below, there is a statement followed by two courses of action numbered I and II. A course of action is a step or administrative decision to be taken for improvement, follow-up or further action with regard to the problem, policy etc. On the basis of the information given in the statement, you have to decide which of the suggested courses of action logically follows for implementation.

Mark your answer as:

- (1) if only I follows.
- (2) if only II follows.
- (3) if neither I nor II follows.
- (4) if both I and II follow.

1. Statement: There is going to be a severe shortage of potable water in the next decade all over the world.

Courses of Action:

- I. India should occupy other countries which have plenty of water.
- II. Scientists should find ways to make sea water potable.

2. Statement: In a majority of the cases where families are ruined, the reason is excessive consumption of alcohol.

Courses of Action:

- I. Government should pass a law banning alcohol in the country.
- II. Awareness campaigns should be conducted on a large scale to warn people of the ills of alcohol addition.

3. Statement: Three inmates of a juvenile rehabilitation camp are found to be missing.

Courses of Action:

- I. The warden of the camp should be dismissed.
- II. All the inmates should be shifted to a jail.

4. Statement: Terrorism is playing havoc with tourism industry.

Courses of Action:

- I. Security measures at tourist spots should be beefed up.
- II. Tourists should be advised of the care that they should take.

5. Statement: Hoarding of food grains is leading to rise in prices of food grains.

Courses of Action:

- I. The government should take steps to produce more food grains.
- II. The government should form a special task force to locate and release the hoarded food grains

6. Statement:

The price of crude oil has touched \$144 per barrel. This rise in price is causing huge loss to the government subsidizing oil prices.

Courses of Action:

- I. The government should stop subsidising oil prices.
- II. The government should invest in research on alternate sources of energy.

7. Statement:

The US senate has passed the bill to provide health insurance to all its citizens.

Courses of Action:

- I. The government should take requisite steps to ensure proper implementation of the bill.
- II. The government should provide free doses of Tamiflu, to all its citizens, to fight against swine flu which has been declared a pandemic now.

8. Statement:

The overbridge in Delhi collapsed last week killing 11 people who were working in the bridge at the time of collapse.

Courses of Action:

- I. The government should take action against Gammon Infra which was constructing the bridge.
- II. The government should remove the cost constraints that have been incorporated into the project.

9. Statement:

The deficit in rainfall this monsoon had led to the prospect of drought in 25% of the country.

Courses of Action:

- I. The government should provide drought resistant seeds to farmers.

- II. The government should invest more in infrastructure to balance the losses faced by the country.

10. Statement:

The government is making arrangements for the commonwealth games scheduled for next month in Delhi.

Courses of Action:

- I. The government should build a bridge to be able to regulate the flow of traffic during the games.
- II. The government should introduce a green campaign thought the country.

Directions for questions 11 to 17: In each question below, a statement is given followed by three courses of action numbered I, II and III. A course of action is a step or administrative decision to be taken for improvement, follow-up or further action in regard to the problem, policy etc., on the basis of the information given in the statement. You have to assume everything in the statement to be true, then decide which of the three suggested courses of action logically follows for pursuing.

11. Statement:

Owing to rigging during polls in democratic states, the deserving candidates lose the elections.

Courses of Action:

- I. Democracy must be abolished.
 - II. People must be educated about the value of their vote and they should be made to cast their vote.
 - III. Military force should be employed at every polling booth, where the chance of rigging is high.
- (1) Only II and III follow
 - (2) Only II follow
 - (3) Either I or III follows
 - (4) Only III follows

12. Statement:

It is because of a multiparty system in our country that a coalition government is formed, wherein the country suffers from instability.

Courses of Action:

- I. There should be only a bi-party system and to this extent the constitution must be amended.
- II. Whenever any party is not in the majority, the elections must be held again.
- III. If there is no absolute majority for any national party, the President should dissolve the

Parliament and he should rule the country during that period.

- (1) Only II and III follow
- (2) Only I and II follow
- (3) Only I and III follow
- (4) None of these

13. Statement: Excess usage of pesticides has resulted in pests developing immunity. Thereby farmers are suffering from heavy loss in their crops as a result of these resurgent pests.

Courses of Action:

- I. Farmers should stop using pesticides.
 - II. Research must be done in producing hybrid varieties which are very strong and cannot be destroyed by pests.
 - III. Farmers should stop growing crops for some time.
- (1) Only II follows
 - (2) Only III follows
 - (3) Only I follows
 - (4) None follows

14. Statement: Cutting down of forests is a threat to the wild life. Most of the species of animals are on the verge of extinction.

Courses of Action:

- I. The species of animals, which are on the verge of extinction, must be protected by creating wild life sanctuaries which contain flora that defines the native habitat of the endangered animals.
 - II. To the maximum extent possible we should stop deforestation.
 - III. Growing urban forests to compensate for deforestation.
- (1) Only II follows
 - (2) Only III follows
 - (3) Only I and II follow
 - (4) Only I follows

15. Statement:

Out of every hundred people who are blind, twenty people go blind because of the deficiency of Vitamin 'A'. But this fact is not known to illiterates and it is neglected by the educated.

Courses of Action:

- I. Literacy programmes must be launched to educate people regarding the importance of vitamins.

- II. Educated people must be punished.
- III. As television is the main media which reaches 80% of the population, the government should make a small feature film, explaining the significance of various vitamins.

- (1) Only I follows
- (2) Both I and III follow
- (3) Either II or III follows
- (4) All follow

- 16.** Statement: Food kiosks, rickshaw stands, hawkers and car repair shops, that are multiplying on the city's pavements, is leading to congestion. Residents of ground floor flats and buildings near markets are the worst affected as a result.

Courses of Action:

- I. Hawkers should be evicted from the pavements.
- II. All encroachments should be immediately removed.
- III. Residents should relocate to more peaceful surroundings.

- (1) Only I follows
- (2) Both I and II follow
- (3) Only II follows
- (4) All follow

- 17.** Statement:

The US state department, after pursuing several leads, has warned that the scheduled execution of a Pakistani convicted of murdering two US citizens could trigger retaliatory attacks on US interests overseas. Prime among them include recreational places like beaches and resorts.

Courses of Action:

- I. US military forces in foreign lands should exercise extreme caution and be on high alert.
- II. All terrorists in the US should be immediately executed.
- III. High security should be provided at all beaches and resorts.

- (1) Only I follows
- (2) Both I and II follow
- (3) Both I and III follow
- (4) All follow

Directions for questions 18 to 20: Select the correct alternative from the given choices.

- 18.** A five-year-old boy, Sakti, was washed away in on overflowing nala following a downpour. This is third

such tragic death in the past three months. A 10 year old girl and a 7 year old boy died after slipping into the nala in the same locality after heavy rains. The nala is also a source of diseases.

Which of the following would be the most appropriate course of action to solve the problem?

- (1) Cover the entire nala.
- (2) Make the place prohibited for the children during rainy season.
- (3) Construct a sidewall beside the nala in that locality so that the children cannot reach the nala.
- (4) Divert the excess water to a different nala.

- 19.** A feud between two communities has created a rift among school children on caste lines in a remote village. Children belonging to a particular caste are now skipping the mid-day meal because the cook belongs to a different caste. A boy revealed that his parents had advised him to come home for lunch by skipping the mid-day meal served at school.

Which of the following would be the most appropriate course of action to solve the problem?

- (1) Stop the mid day meal scheme.
- (2) Change the cook.
- (3) Close the main gate of the school and force the students to have mid-day meal in the school.
- (4) The children should be made aware of the caste system and tell them that the people of all castes are human beings and caste makes no difference.

- 20.** The drainage facility is not proper in city 'A'. The existing drains are too small to drain the rainwater, leading to floods. The citizens of the city find it very inconvenient. It is also observed that most of the entry points, where the rainwater enters the drains, are choked with plastics and other garbage.

Which of the following would be the most appropriate course of action to solve the problem?

- (1) Revamp the drainage system and periodically check the openings.
- (2) Ensure that the rain water does not flow in to drains.
- (3) Keep the openings away from the locality so that the openings would not be choked.
- (4) Store the rainwater in a large reservoir by pumping and process the water to make it potable.

ANSWER KEYS

PRACTICE EXERCISE 16 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 3 | 4. 1 | 5. 1 | 6. 1 | 7. 1 | 8. 2 | 9. 1 | 10. 4 |
| 11. 1 | 12. 4 | 13. 2 | 14. 2 | 15. 4 | 16. 3 | 17. 2 | 18. 1 | 19. 4 | 20. 4 |

PRACTICE EXERCISE 16 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 3 | 4. 4 | 5. 2 | 6. 3 | 7. 1 | 8. 3 | 9. 1 | 10. 3 |
| 11. 1 | 12. 4 | 13. 1 | 14. 3 | 15. 1 | 16. 3 | 17. 3 | 18. 1 | 19. 4 | 20. 1 |
-

Cause and Effect

INTRODUCTION

Cause and Effect

Questions based on cause and effect test the ability of the candidate to determine the relation between two events and examine how they are dependent on each other i.e., which of them is the cause for the other one. The directions for different types of these questions are given below.

Type – I Directions

Directions for questions: Each of these questions contains a pair of events marked as 'A' and 'B'. You have to read both the events and decide their nature of relationship. You have to assume that the information given in 'A' and 'B' is true and you will not assume anything beyond the given information in deciding the answer.

Mark answer

- (A) if 'A' is the effect and 'B' is its immediate and principal cause.
- (B) if 'A' is the immediate and principal cause and 'B' is its effect.
- (C) if 'A' is an effect but 'B' is not its immediate and principal cause.
- (D) if 'B' is an effect but 'A' is not its immediate and principal cause.

Type – II Directions

Directions for questions: Below in each question are given two statements (A) and (B). These statements may be either independent causes or may be effects of independent causes. One of these statements may be the effect of the other statement. Read both the statements and decide which of the following answer choices correctly depict the relationship between these two statements.

Mark answer

- (A) if statement (A) is the cause and statement (B) is its effect.
- (B) if statement (B) is the cause and statement (A) is its effect.
- (C) if both the statements (A) and (B) are effects of independent causes.
- (D) if both the statements are effects of some common cause.

Type – III Directions

In each of the following questions, a statement is given followed by few consequences which may arise out of the facts stated in the statement. You have to find out which of the consequences directly follow(s) from the statement and mark your answer accordingly. Let us discuss the concepts involved in these questions taking a few examples.

Type – I**Example (1):**

Event (A): Mr Amitab Bachchan received the best actor award.

Event (B): Mr Amitab Bachchan is a good actor.

From the directions given for these questions, it is clear that, first one has to find out whether the given events are related or not. Here, one event talks about award to an actor, and the second statement talks about what kind of an actor that person is. Hence, the events are related events. Now, answer choice (5) is eliminated. The possibility of choice (5) being the answer arises even when the given events are related. That will be discussed ahead. Once it is found out that the events are related, one should check the chronological order in which they occur. Because in a cause and effect relation the cause occurs before the effect.

If event (A) occurs before event (B), it implies that A is the cause and B is its effect. In this case choices (B) and (D) are the possible answers. On the other hand if event (B) occurs before event (A), then choices (A) and (C) prevail.

After identifying the possible answer choices, the task is to identify whether the cause is a principal and immediate one or not. Here, we have to understand the terms 'immediate' and 'principal'.

If a camel cannot live at the poles, it is because the weather conditions there do not suit its anatomy. If non-availability of grass is shown as a cause, it is of course a cause, but it is a trivial one.

Similarly, an object has to be combustible for it to get burnt. Being combustible is a principal cause for a heap of paper to burn but it is not an immediate one. Some one throwing lighted match stick onto the heap would be the immediate cause. For a cause to be an immediate one, the time frame is irrelevant. If no other intermediary cause is required, then it is said to be the immediate one. Increase in vehicular traffic is an immediate cause for widening the roads. But the increase in vehicular traffic does not occur overnight or in a day, still it is an immediate cause.

Choice (A) or (B) can be selected, only if both the conditions, principal and immediate, are satisfied. If any one or both condition(s) is/are not satisfied then one should go for choice (C) or (D).

Type – II

If the given statements are related and they can be arranged in a chronological order, one should go for choice (A) or choice (B) depending on which of the two causes the other one.

Example (2):

Statement (A): Many high-rise buildings, bridges and dams collapsed.

Statement (B): Farmers claimed heavy losses as lakhs of acres of agricultural land along the bank of river Ganga got immersed.

Solution:

It is clear that statement (A) is an effect of an earth quake and statement (B) is an effect of floods. As these two are effects of independent causes, the answer is choice (C).

Example (3):

Statement (A): Farmers suffered heavy losses as lakhs of acres of agricultural land along the bank of the river Ganga were inundated.

Statement (B): Many villagers living along the bank of the river Ganga were left homeless as their houses have been washed away.

Solution:

The given statements represent the effects of a common cause, i.e., floods in the river Ganga. Hence the answer is choice (D).

Type – III**Example (4):**

Statement: The government has decreased the cost of petrol drastically, while it marginally increased the cost of diesel, bringing the cost of petrol and diesel very close to each other.

Possible consequences :

(A): The demand for petrol vehicles may increase.

(B): The demand for diesel vehicles may decrease drastically.

(C): The transport costs may vary.

(1) Only (A) and (C) (2) Only (A) and (B)

(3) Only (B) and (C) (4) All of them

The decrease in the cost of petrol may lead to an increase in the demand for petrol driven vehicles. Hence, (A), is a possible consequence. A slight increase in the cost of diesel may not lead to a drastic decrease in the demand for diesel driven vehicles. Hence, (B) is not a possible consequence. As the cost of petrol has decreased drastically and the cost of diesel has increased slightly, and the two are the net effect on transport charges may vary. Hence, (C) is a possible consequence. Hence, choice (A) is the answer.

While answering type II and type III questions one has to keep in mind that the cause or the consequence should be directly related to the given statement.

PRACTICE EXERCISE 17 (A)

Direction for questions 1 to 10: Given below are pairs of events 'A' and 'B'. You have to read both the events 'A' and 'B' and decide the nature of relationship between them. You have to assume that the information given in 'A' and 'B' is true and you will not assume anything beyond the given information in deciding the answer.

Mark answer:

- (1) If A is the effect and B is its immediate and principal cause.
 - (2) If B is the effect and A is its immediate and principal cause.
 - (3) If A is the effect and B is not its immediate and principal cause.
 - (4) If B is the effect and A is not its immediate and principal cause.
1. Event A: John loves animals and has lots of pets.
Event B: John received an award from the Wild Life Federation.
 2. Event A: A national level "Bio Pharma" event is being organized by Sun Pharma for which the President is the chief guest.
Event B: Large scale security measures and traffic regulations are being made.
 3. Event A: The cost of petrol has been increasing continuously and steeply for the past two years.
Event B: Timtim, the automobile company which manufactures only cars that run on petrol is on the brink of bankruptcy due to lack of sales.
 4. Event A: Sita is suffering from fever for the past three days despite having medicines described by the doctor.
Event B: The doctor who prescribed medicines to her is not her family doctor.
 5. Event A: A survey has shown that FMCG goods are in great demand in India and this demand is expected to increase by 20% in the next five years.
Event B: Many multinational FMCG companies are seeking to enter the Indian market.
 6. Event A: The farmers will be affected immensely as they are unable to sow seeds for the new season.
Event B: India is facing a delayed monsoon this year.
 7. Event (A): Most of the MNCs are reeling under recession.

Event (B): The increments provided to the employees of MNCs have been drastically reduced.

8. Event A: India has received information that terrorists have planned an attack on India.
Event B: India is planning to implement a fool proof security system by spending ₹5,000 crores against terrorist attacks.
9. Event A: An earthquake of magnitude 8.7 rocked parts of China.
Event B: Many multistoried buildings collapsed in China.
10. Event A: Polar ice caps are melting owing to Global warming.
Event B: The coastline in Maldivan Islands is decreasing steadily.

Directions for questions 11 to 15: Below in each question are given two statements A and B. These statements may be either independent causes or may be the effects of independent causes. One of the statements may be the effect of the other statement. Read both the statements and decide which of the following answer choices correctly depict the relationship between these two statements.

Mark answer

- (1) if statement A is the cause and statement B is its effect.
 - (2) if statement B is the cause and statement A is its effect.
 - (3) if both the statements (A) and (B) are effects of independent causes.
 - (4) if both the statements are effects of some common causes.
11. (A) The opposition parties staged a protest at the entrance of the parliament house on September 4.
(B) A naval exercise in which India, Australia, Japan, Singapore and the United States participated, started in the Bay of Bengal on September 4. The opposition parties are not in favour of this.
 12. (A) A disease called conjunctivitis (also called Madras eye) prevailed in the state of Andhra Pradesh where one in every five people were effected.
(B) A large number of people from Madras migrated to Andhra Pradesh.

13. (A) The Board of Control for Cricket in India (BCCI) announced the launch of the Indian Premier league.
(B) The Indian Cricket league which was formed recently (in opposition to the BCCI) was the first to launch a premier league.
14. (A) Shinzo Abi has resigned as the Prime Minister of Japan.
(B) This is an ignominious exit for Shinzo Abi who was once perceived as the standard bearer of the new generation of Japanese politicians.
15. (A) The problem of child labour has reached epidemic proportions in India with the number of child labourers increasing from 12 million to over 40 million child workers.
(B) The India has the worlds largest number of child labourers.

PRACTICE EXERCISE 17 (B)

Directions for questions 1 to 15: Below in each question are given two statements A and B. These statements may be either independent causes or may be the effects of independent causes. One of the statements may be the effect of the other statement. Read both the statements and decide which of the following answer choices correctly depict the relationship between these two statements.

Mark your answer as:

- (1) if statement A is the cause and statement B is its effect.
- (2) if statement B is the cause and statement A is its effect.
- (3) if both the statements (A) and (B) are effects of independent causes.
- (4) if both the statements are effects of some common cause.

1. Event A: Police is taking strict action against any case of ragging that is brought to its notice.

Event B: The government has set up exclusive phone lines which can be used by the students to bring to its notice any occurrence of ragging in the campus.

2. Event A: Tom Grisham has resigned as the Managing Director of Jord motors.

Event B: The exit of Tom Grisham is an ignominious one for a person who was considered to be responsible for bringing in sky rocketing sales for the company.

3. Event A: The number of pregnancy deaths that occur in India has only increased over the past years with about 1.17 lakh cases being reported from India alone out of a total of 5.23 lakh cases reported throughout the world.

Event B: India has the world's largest number of pregnancy related deaths.

4. Event A: The government was set up the Unique Identification Authority of India.

Event B: The authority has been given a budget allocation of ₹100 crore for its first year of existence.

5. Event A: The US government has announced that it would close down the Guantanamo Bay by the end of August.

Event B: The US government has been largely criticized for the methods of torture that are being used on the detainees at Guantanamo Bay.

6. Event A: The death of Michael Jackson has saddened many people throughout the world.

Event B: Michael Jackson, had started his career at an early age of 10 with Jackson 5.

7. Event A: The Indian government has decided to issue unique identification cards to all its citizens.

Event B: The Indian government has proposed the Food Security Act.

8. Event A: The US citizens did not save even a small part of their income and are habituated to spending a major portion of their income on food and pleasure trips.

Event B: The US citizens are severely effected by economic slow down.

9. Event A: With a boom in the IT sector, a large number of Indians are now willing to spend on luxury goods and branded items.

Event B: Enigma, a luxury brand has decided to set up 12 new outlets across the country in the next one year.

10. Event A: The stars of the low budget movie "Slumdog Millionaire" which is based on real issues, are in huge demand.

Event B: More number of bollywood directors are now looking forward to making low budget movies, which are based on real issues.

11. (A) An earthquake of magnitude 8.2 rocked the islands of Maldives.
 (B) A devastating Tsunami struck the coastal belt of Maldives.
12. (A) The Greenland ice cap is melting so quickly that pieces of ice which are several cubic kilometers in size are breaking off.
 (B) Greenland is prone to earth quakes.
13. (A) The destiny of Asia will be shaped by the triangular relationship between the Asian nations, India, China and Japan.

(B) India, China and Japan which have registered a phenomenal growth, over the last decade in particular, has acted as southern engines of growth for the whole world.

14. (A) India's diabetes drugs market is growing 16.7% annually. It will cross \$1.1 billion by 2012.
 (B) Advinus Therapeutics, Tata's drug discovery enterprise, had its research areas involving diseases like malaria, diabetes and asthma.
15. (A) Norms and guidelines help children learn mutual respect, responsibility and cooperation.
 (B) There are times when the enforcement of norms and lead to conflicts.

ANSWER KEYS

PRACTICE EXERCISE 17 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 4 | 2. 2 | 3. 2 | 4. 3 | 5. 2 | 6. 1 | 7. 2 | 8. 4 | 9. 2 | 10. 4 |
| 11. 2 | 12. 3 | 13. 1 | 14. 4 | 15. 1 | | | | | |

PRACTICE EXERCISE 17 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 4 | 2. 4 | 3. 1 | 4. 4 | 5. 2 | 6. 3 | 7. 3 | 8. 1 | 9. 1 | 10. 4 |
| 11. 1 | 12. 1 | 13. 2 | 14. 4 | 15. 4 | | | | | |

Strong and Weak Arguments

INTRODUCTION

Some examinations consist of questions based on identifying strong and weak arguments. In these questions, a proposal followed by two arguments is given. One has to examine the arguments in the context of the given proposal so as to determine their strength. The statements given in these questions, normally, are of interrogative nature.

Before discussing the methodology of solving the questions, let us discuss the two important concepts, “Proposal” and “Argument”.

Proposal

Most of the questions are based on a “Proposal”. A proposal, here, means a course of action to be taken up.

Example:

- (1) Should liquor be banned?
- (2) Should wild-life be preserved?

Argument: A proposal is followed by two arguments. An argument maybe in favour of or against the proposal. One has to check the strength of the argument. This cannot be misconstrued as considering only favourable arguments. It is irrelevant whether an argument is favourable or adverse to a proposal. Both favourable and adverse arguments are considered provided both of them are strong enough in their own ways.

The supporting argument normally bases its support on a positive result or a positive feature, that would follow, on implementing the course of action proposed in the statement. Similarly, the opposing argument takes its support on the basis of a negative result or a negative feature that (it thinks) follows if the proposed course of action is implemented.

Strength of an argument: An argument is considered to be strong, if it provides a valid and directly related reason either in favour of or against the proposal made.

While considering the arguments, one has to adhere to the following norms:

- (1) The argument is to be considered true, unless it is opposing the generally accepted facts. In other words, the authenticity of the argument cannot be questioned as long as it is not against established facts.

For example, if one argument suggests that Mohd. Ali is stronger than Mike Tyson, we have to take it as true.

- (2) Personal opinion about the proposal shall be ignored. Even if one has an opinion about the proposal, in discussion it cannot be taken into consideration. In other words, the judgement should always be unbiased.
- (3) Sometimes one may come across a situation in which an argument [say “India should declare war against the whole world”] is absurd. But if it is strong enough in the given context it has to be taken as a strong argument. One cannot deny this argument terming this as absurd.

To determine the strength of an argument, one has to follow a methodical way which is explained below.

Preliminary Screening

In this stage, the given arguments are read superficially certain arguments are so obvious that they can be eliminated in one glance. Read the argument and discard it if it is :

- ambiguous
- disproportionate
- irrelevant
- comparative
- simplistic

Ambiguous

The argument should have clarity in the reason suggested in it. The argument should be contextual and express its support or opposition to the given statement in explicit terms.

Example:

Statement:

Should India wage war against Pakistan?

Argument:

No, both India and Pakistan are at fault.

Analysis:

Here, though the argument refers to the subject in the statement, it has no clarity. We cannot find out what the argument wants to say. Thus, the argument is ambiguous.

Disproportionate

The reasons given in the argument, in support or against the given statement, should be comparable to the magnitude of the situation given in the statement. It should be neither same as “trying to kill an elephant with a needle” nor “trying to kill a mosquito with a sword”.

Example:

Statement:

Should every citizen be asked to use only pencil to write instead of pen?

Argument:

Yes, usage of pencil leads to reduction in wastage of paper. This helps in protection of environment.

Analysis:

The argument links usage of pencil to protection environment, because errors can be rectified on the same paper

instead of using a new paper and hence wastage of paper can be reduced. This measure, in practice, makes little difference to the environment, hence, the argument is rejected.

Irrelevant

The argument should relate its reasoning to the context given in the statement.

Example:

Statement:

Should the syllabus for primary classes be reduced, to enable the students to understand the concepts piece meal?

Argument:

- I. No, it gives more leisure to students, which may lead to juvenile delinquency.
- II. No, the syllabus should include subjects that help in increasing IQ levels of students.

In the given statement, a course of action is suggested to achieve the ultimate aim of enabling students to understand the subjects better. The arguments should base their reasoning as to whether the suggested action results in achievement of the ultimate aim or not. The reason given in argument (I) is out of context when compared to the statement. Hence, this argument is irrelevant.

Argument (II) has relevance to the above statement, as it reasons on the same lines as the statement. The statement should include whatever it wants to achieve through the suggested course of action.

Comparative

The argument should suggest why or why not the proposed action be implemented, basing on favourable or adverse results that follow after implementation. But it should not support or deny the suggestion, because such action has been taken up or not taken up elsewhere.

Example:

Statement:

Should India reform its taxation policy?

Argument:

- I. Yes, it helps in rationalization of taxes.
- II. Yes, many countries are doing so.

Analysis:

Argument (I) is a valid argument because it is based on a positive result that would follow the suggested action.

Argument (II) is not based on any resulting effect of the suggested action. It is only comparing with other countries. Others may have their own reasons for taking up such measures. Hence, this is not a valid argument.

Simplistic

These kind of arguments, though they are related to the statements, make a simple assertion or there is no substantiation to strengthen the argument.

Example:

Statement:

Should India wage war against Pakistan?

Argument : I. Yes, it should be done immediately.

Argument : II. No, it is not going to help.

Analysis:

Argument (I) simply suggests that it should be done immediately, but does not give any reason as to why it should be done. Hence, this argument is too simple.

Argument (II) does not show how it is not going to help. Of course, it has shown a reason why such an action should not be taken up, but does not dwell deep into the reason. Hence, argument (II) is also simplistic.

Let us take a few examples to understand how the above methods help in solving questions.

Directions for examples

Mark your answer as Choices

Choice (1) if only statement I is a strong argument.

Choice (2) if only statement II is strong argument.

Choice (3) if both I and II are strong.

Choice (4) if neither I nor II is a strong argument.

Example:

Statement: Should male labourers be paid more than female labourers?

- I. Yes. Even physiologists confirm that the structure of male body is such that males can do more work when compared to females, in a fixed period of time.
- II. No. This puts a question mark over gender equality in the society.

👉 Solution:

Argument I: It talks about the opinion of physiologists. Here, we cannot check the validity of the physiologists' opinion. We have to assume that the information given is true and check whether such information supports the proposal strongly. If the information is true, then it gives a valid reason for higher wages given to males. Hence, this is a strong argument.

Argument II: There are many factors which cause inequality in the society. Lower wages is not a cause for inequality. Therefore, argument II cannot be considered a strong argument. Only statement I is a strong argument. **Choice (1)**

TRUTH IN THE ARGUMENT

Here, we check whether the result or effect mentioned in the argument does really follow, in the given context, on implementation of the suggested action.

Normally, the result will follow, if

- it is logical,
- it is an established fact,
- it is based on experiences.

The above are only a few limits, but it has to be decided based on sheer commonsense. We discard all such arguments, where the result does not follow.

ADVANTAGE OR DISADVANTAGE OF RESULT

We have already seen that a supporting argument predicts a positive result/ effect on implementing the suggested action. Now, let us consider those arguments, where the result mentioned therein follows.

In this, we will try to figure out whether the predicted positive result, in case of supporting argument, is beneficial or not. Similarly, in case of opposing argument, we will try to figure out whether the predicted result is really disadvantageous. If the predicted result is beneficial/disadvantageous, then the argument is considered to be strong.

The argument, that is filtered through these three steps, is considered to be a strong argument.

The following example helps in a clear understanding of the above discussion.

Example:

Statement:

Should interest rates on bank deposits be increased to attract more customers?

Arguments:

- (1) Yes, people get attracted towards higher interest rates on their savings.
- (2) No, in present scenario, people are giving preference to safety of their funds.
- (3) No, it leads to inflation.
- (4) Yes, the interest rate on advances is already hiked.
- (5) Yes, many banks are doing so.

Analysis:

From the statement, it is clear that the action (increasing interest rates on deposits) is suggested to achieve a specific goal i.e., attracting more customers. In this case, the arguments should base their support on whether or not such goal can be achieved through the suggested action.

Arguments (3), (4) and (5) do not talk about attracting customers. Hence, these are not strong arguments as they are irrelevant to the context.

Moreover, argument (5) is a comparative one. Comparative arguments are not strong arguments.

Argument (1) supports the statement by showing a reason for customers to get attracted.

Argument (2) opposes the statement by indicating why the suggested action would not help in achieving the goal.

Thus, arguments (1) and (2) are strong for their own reasons.

If the given statement does not attach any purpose for the proposed action, the way we look at the argument changes. Now, observe how the previous statement is expressed.

Statement:

Should interest rates on bank deposits be increased?

Analysis:

Now, the question of relevance does not arise, because the statement does not attach any purpose for the suggested action, any purpose/disadvantages of such action can be given as an argument. In any case, argument (5) is a weak argument because it is comparative.

Argument (1) based its support on a positive result (attraction of new customers), which is beneficial to the bank. Hence, argument (1) is strong.

Argument (2) suggests that the bank should concentrate on ensuring safety of funds, which is the need of the hour, but not increasing interest rates. In the present scenario, argument (2) is strong.

Argument (3) bases itself on a negative effect that would follow such action. If interest rates on deposits are

increased, banks tend to increase interest rates on advances as well, in order to maintain profitability. This leads to increase in cost of production. Ultimately, this leads to inflation.

Here, we can see that the result obtained above logically follows the argument, as it is an established fact that increase in inflation is harmful to economy. Thus, argument (3) is strong.

Argument (4) does not give any valid reason as to why the interest rates be increased due to increase in the interest rates on advances. Hence, argument (4) is weak.

Before going to the exercise, let us summarize the above discussion.

Summary:

- (1) A supporting argument bases its support on a positive result/effect that follows if the proposed action is implemented and an opposing argument bases itself on a negative result/effect.
- (2) The strength of an argument is checked through the following four steps.
 - (i) Preliminary screening—Discard all such arguments which are ambiguous, simplistic, disproportionate, irrelevant or comparative.
 - (ii) Truth in the argument—Check whether the result/effect discussed in the argument really follows.
 - (iii) Desirability/Harmfulness—If the result/effect follows, check whether such result is really desirable/harmful.
- (3) An argument which is filtered through the above three steps is called a strong argument.
- (4) Take help of generally accepted facts, past experiences, etc., in analysing the strength of an argument.

PRACTICE EXERCISE 18 (A)

Directions for questions 1 to 11: In making decisions about important questions, it is desirable to be able to distinguish between strong arguments and weak arguments so far as they are related to the question. Weak arguments may not be directly related to the question, may be of minor importance or may be related to some trivial aspect of the question. Each question given below is followed by two arguments numbered I and II. You have to decide which of the arguments is strong and which is weak.

Mark your answer as

Choice (1) if only statement I is a strong argument.

Choice (2) if only statement II is strong argument.

Choice (3) if both I and II are strong.

Choice (4) if neither I nor II is a strong argument.

1. Should there be a law to punish parents who get their minor children married?
 - I. Yes: A minor girl is physiologically not prepared to conceive a baby.
 - II. No: This has been a custom prevailing since many centuries.
2. Are there any good politicians left in this world?
 - I. Yes: So many poor people are sustaining themselves and improving economically.
 - II. No: There is nothing in this world which is completely good or completely bad.
3. Should the teachers be stopped from beating the students?
 - I. Yes: Child psychologists say that beating hinders the learning process in a child.
 - II. No: Spare the cane and spoil the child.
4. Should Simons, a hardware company, enter the software industry?
 - I. Yes: If there is an indigenous software development wing, the Research and Development of hardware would be more effective.
 - II. No: Software industry is in recession.
5. Should the manufacturing of leather products be prohibited?
 - I. Yes: Killing animals for any reason other than survival is making the environment dangerous.
 - II. No: Leather products are the biggest foreign exchange earners.

6. Should the director with political influence be preferred to the director with vast experience for the post of managing director?
 - I. Yes: Now a days, business becomes successful by exercising influence rather than using strategies.
 - II. No: Strategies developed by an experienced businessman makes a business definitely successful.
7. Should rail-roads be privatised?
 - I. Yes: It is not possible to supervise an organization as big as a rail-road by any private company.
 - II. No: Privatization makes train-journey expensive.
8. Should foreign print media be allowed to enter the Indian market?
 - I. Yes: Indian media networks are not so effective as foreign media networks are.
 - II. No: Valuable, confidential governmental information would be put at stake.
9. Should the neighbouring country be given free food grain supply?
 - I. Yes: This country is severely affected due to a series of natural calamities.
 - II. No: This country has always been our enemy.
10. Should concrete roads be built all over the country instead of bitumen roads?
 - I. Yes: As concrete road lasts 10 times longer than bitumen roads, saves 20% in terms of fuel burnt by vehicles and is cheaper to lay than bitumen roads.
 - II. No: Many of the developed countries do so.
11. Should personal interviews be removed from the recruitment process for government jobs?
 - I. Yes: This is where corruption plays a major role and it has become evident that this can never be eliminated.
 - II. No: The integrity of a person can best be judged only through personal interaction.

Directions for questions 12 to 15: Select the correct answer from the given choices.

12. Statement:

A majority of the 300 communication, remote sensing and scientific spacecrafts operating at an altitude between 700 and 800 km face a substantial risk of being destroyed by the debris created by the break-up

of China's Fengyun 1-C spacecraft. There are about 2500 pieces of debris of the size of 10 cm which reside in long-lived orbits. About 15 to 20 pieces were a few meters long.

Which of the following, if true, would strengthen the apprehension expressed in the above question?

- (1) Increase in the amount of debris enhances the probability of collision, thereby destroying operational spacecrafts.
- (2) The risk is from the pieces which are a few meters long. The smaller pieces would not cause any damage, even if they collide with the spacecrafts.
- (3) Most of the debris, after the break-up of Fengyun, were thrown into the orbit above 800 km.
- (4) Among the 300 spacecrafts, nearly 20% have become dysfunctional.

13. Statement:

People having strong religious faith do not require archaeology and history to keep their faith intact. Faith finds its own place and function, as do archaeology and history. The place and function of each is separate.

Which of the following, if true, would strengthen the argument made above?

- (1) Faith depends on the experience and the knowledge of the past.
- (2) Most of the history contains conflicts among different religions.
- (3) Faith propagates from person to person by birth and by practice of certain religious activities.
- (4) The society was divided based on the professions but not based on the religion.

14. Statement:

The next morning, I looked down at the city of Shillong from a hilltop and felt that this has to be a foreign land. It was too beautiful to be India.

Which of the following, if true, would seriously weaken the author's assumption?

- (1) There are many dirty cities in India.
- (2) The author has lived in beautiful cities only.
- (3) Any city when looked from a hilltop appears beautiful.
- (4) There are many cities in India which are more beautiful than Shillong.

15. Statement:

Earlier the age of any world chess champion used to be 30 plus and a champion used to reign supreme for a long period. The future of the game is not going to be the same. One may find that a champion is of less than 25 years of age and a champion may not find place in the top ten in the following championship.

Which of the following, if true, would weaken the forecast made about the game?

- (1) Mr Anand, the latest champion, said there will be little time for him to relish the title.
- (2) The average age of the contestants in the recently concluded championship is 20 years.
- (3) Forty year old Mr X, a champion a decade ago, who was ranked below 200 for the past five years, struck back and ended as a runner-up in the latest championship. He was the only player who threatened the champion.
- (4) No major tournaments are being conducted at the junior level.

PRACTICE EXERCISE 18 (B)

Directions for questions 1 to 11: In making decisions about important questions, it is desirable to be able to distinguish between strong arguments and weak arguments so far as they are related to the question. Weak arguments may not be directly related to the question, may be of minor importance or may be related to some trivial aspect of the question. Each question given below is followed by two arguments numbered I and II. You have to decide which of the arguments is strong and which is weak.

Mark your answer as

Choice (1) if only statement I is a strong argument.

Choice (2) if only statement II is strong argument.

Choice (3) if both I and II are strong.

Choice (4) if neither I nor II is a strong argument.

1. Should the institute conduct classes in remote villages?

- I. Yes: This will help those students who belong to villages and cannot visit urban areas for studies.
- II. No: This is not an economically viable proposal, as the number of students who attend such classes cannot contribute to break-even.

2. Are these sanctuaries, which are meant to protect the endangered animals, necessary?

- I. Yes: These are necessary as it is our responsibility to conserve environment and to provide posterity with a better world to live in.
 II. No: These are a huge burden on our receding economy.
3. Should there be an upper age limit for a person to assume the post of prime minister?
 I. Yes: A leader must not only be wise and experienced but also be energetic and young enough to understand the trends of the world.
 II. No: Older the leader, better he is, as he can lead more effectively owing to his experience.
4. Is it wise on the part of the government to disinvest from PSUs?
 I. Yes: Overheads of PSUs are increasing making the total cost of production higher and higher.
 II. No: The fundamental purpose of PSUs is to provide employment to the people.
5. Should Yoga be introduced as a part of the curriculum by schools?
 I. Yes: This will help students improve their mental ability.
 II. No: This will not help students to improve studentship qualities but will burden them with extra school-hours.
6. Should children be allowed to use internet in internet kiosks.
 I. Yes: All the internet kiosks are using filter-software's, which do not allow adult software to be downloaded.
 II. No: Internet is a communication medium, which transmits information and does not distinguish between a child and a grown-up.
7. Statement:
 Should a policeman be posted at the junctions which has traffic signals functioning accurately?
 Arguments:
 I. Yes, as many people do not follow traffic signals, it is necessary to monitor them.
 II. No, if every citizen is responsible and they all follow the traffic rules, policemen are not needed at such junctions.
8. Statement:
 Should Zipher, a telecom company, establish itself in India?

Arguments:

- I. Yes, India is one of the fastest growing telecom economics in the world.
 II. No, the demand for telecom services in India is at an all time low.

9. Statement:

Should flyovers be built in busy traffic areas?

Arguments:

- I. Yes, it will help in reducing the traffic jams at several junctions.
 II. No, it is a tedious process to build flyovers especially in busy traffic prone areas, which will worsen the traffic conditions during construction.

10. Statement:

Is Mr X the right person to be the captain of the KKR team in IPL?

Arguments:

- I. Yes, he is highly experienced and his captaincy lead India to victories.
 II. Yes, no other person in the KKR team can match up to his standards in captaincy.

11. Statement:

Should playing a sport be made compulsory for every student at school level?

Arguments:

- I. Yes, there is very high competition as the child grows up to achieve his/her goal.
 II. No, it is important to devote one's entire time for studies.

Directions for questions 12 to 15: Select the correct answer from the given choices.

12. Statement:

India has signalled its intention to send a spacecraft to Mars. The laboratories in India and the Indian Universities will be asked to suggest the scientific objectives they would like to achieve in having the Mars mission. But basically, the technical capability to send a spacecraft to Mars exists with India.

Which of the following, if true, would weaken the proposal for the Mars mission?

- (1) The Indian laboratories and universities did not find any useful scientific objectives they could achieve by the proposed Moon mission.

- (2) The Americans have already completed a mission to the Mars.
- (3) The Russians think that a mission to the Mars would not lead to any discovery that would help the humans.
- (4) The Indian laboratories and universities could not suggest any good scientific objective that can be achieved by the Mars mission.

13. Statement:

Batsmen of the Indian cricket team are unable to put together a match winning score. The coach recommended that a specialist batsman be included in the team by replacing one bowler.

Which of the following would weaken the recommendations of the coach?

- (1) Whatever matches that were won by the Indian cricket team, were due to the exemplary performance by the bowlers of the team in those matches.
- (2) Strengthening the batting would increase the pressure on the bowlers.
- (3) If the bowling is not strong, no score put together by the batsmen is sufficient to win the matches.
- (4) The onus of winning the match is always on the batsmen

14. Statement:

When we had a student from the state of Manipur, one of our colleagues, shook his hand warmly and

said, "Welcome to India". The guy from Manipur, spoke with a distinct accent that indeed made him sound foreign to our sensibility. But so did the guy from the state of Kerala. However, the latter was not treated as a foreigner.

Which of the following, if true, would best explain the above paradox?

- (1) There was a precedent of students from Kerala.
- (2) The colleague, who is from Kerala, came across a person from Manipur for the first time.
- (3) The colleague is not from Manipur.
- (4) The accent of the Keralite is not distinct.

15. Statement:

The arrest orders issued by the High Court for contempt of court, against a journalist, who published a cartoon, which depicted a sitting judge as a corrupt person, received widespread flak from the fourth estate. It is viewed as a threat against the freedom of press. The association of journalists have appealed to the Supreme Court against the High Court's order.

Which of the following observations, if made by the Supreme Court, would strengthen the order issued by the High Court?

- (1) The judge, whom the cartoon depicted, is an up-right person.
- (2) The High Court acted in the interest of justice and not in an attempt to preserve its dignity.
- (3) The journalist was once a judge.
- (4) The judge was once a journalist.

ANSWER KEYS

PRACTICE EXERCISE 18 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 1 | 2. 4 | 3. 1 | 4. 2 | 5. 4 | 6. 2 | 7. 3 | 8. 3 | 9. 1 | 10. 1 |
| 11. 3 | 12. 1 | 13. 3 | 14. 4 | 15. 3 | | | | | |

PRACTICE EXERCISE 18 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|------|------|------|------|-------|
| 1. 3 | 2. 3 | 3. 3 | 4. 4 | 5. 3 | 6. 1 | 7. 1 | 8. 3 | 9. 1 | 10. 3 |
| 11. 4 | 12. 4 | 13. 3 | 14. 2 | 15. 2 | | | | | |

Assertion and Reason

INTRODUCTION

Assertion is nothing but a statement of facts, stating something with force. In other words, a statement made with a strong belief or basing on a strong reason is called an assertion. In these kinds of statements, whatever is mentioned in the statement is backed or supported by a strong reason. Hence, the statement is termed as an 'Assertion'. In each question, an 'Assertion' is followed by one or more "Reasons", which form the basis for such an assertion. The exercise is to find out which, out of the stated reasons, would be the basis for the given assertion. The reasons given in the question should be treated independent of each other. One has to find out whether each of them could be a reason for the given assertion, but not a comparative or a combined

assessment. Reasons given should be directly related to the assertion.

Format of the Question

Directions: In each of the following questions, an assertion is followed by two reasons RI and RII. Read the assertion carefully and decide which among RI and RII is one possible reason.

Mark your answer as

- (1) if only RI is a possible reason.
- (2) if only RII is a possible reason.
- (3) if both RI and RII are possible reasons.
- (4) if neither RI nor RII are possible reasons.

Solved Examples

1. Assertion:

Raj's father is admitted to hospital.

RI: Raj's father suddenly collapsed in his office.

RII: Raj's father is 80 years old.

👉 **Solution:** RI could be a possible reasons.

RII is not a possible reason because a person getting admitted to hospital only because of old age is unlikely.

Choice (1)

2. Assertion:

The students of class X were given grace marks in the board exam.

RI: Students did not attempt all the questions.

RII: Some questions in the exam did not come from the prescribed syllabus.

☞ **Solution:** RI cannot be a reason for giving grace marks. Board does not take responsibility when students do not prepare for the exam or do not attempt questions.

RII is a possible, because only then will the board be constrained to give grace marks.

Choice (2)

3. Assertion:

Mother scolded the son and warned him not to repeat the mistake.

RI: The son had stolen money.

RII: The son lied to his mother.

☞ **Solution:** Each of them is a possible reason. Hence, both follow.

Choice (4)

4. Assertion:

The I.C.S.E. 10th class result is very poor in ABC High School this year.

RI: The number of students in the 10th class I.C.S.E. has increased considerably.

RII: The students in I.C.S.E. 10th class belong to different sections of society.

☞ **Solution:** Neither the number nor the composition of students could be a reason for poor result. Hence, neither of them is a possible

Choice (4)

PRACTICE EXERCISE 19 (A)

Directions for questions 1 to 15: In each question below is given an Assertion followed by two reasons numbered RI and RII. Read the assertion carefully and decide which among RI and RII is/are a possible reason.

- (1) only RI and not RII is a possible reason for the assertion.
- (2) only RII and not RI is a possible reason for the assertion.
- (3) both RI and RII are possible reasons for the assertion.
- (4) neither RI nor RII is a possible reason for the assertion.

1. Assertion:

Some people in India are indifferent to the existing reservations in the education and the recruitment fields.

RI. Because these people do not fall under reservation category.

RII. Sometimes reservations cause damage to the merit.

2. Assertion:

India and America have increased the number of strategic dialogues between the two countries.

RI. America and India want to improve bilateral relations.

RII. America and India are scheming against Russia.

3. Assertion:

People, these days, are doing a lot of tele-shopping.

RI. People are watching TV a lot.

RII. People, these days, are not finding time to shop in markets.

4. Assertion:

The president dissolved the 12th Lok Sabha but asked the present government to continue as a caretaker government.

RI. New government cannot be formed immediately.

RII. The country cannot run without a government.

5. Assertion:

Astrological forecasts published in various magazines often vary.

RI. Different astrologers have their own methodology of making predictions.

RII. Different astrologers have studied at different universities.

- 6.** Schools have been directed by the government not to make their students carry heavy bags with lot of books.

RI: The government does not want to burden the students by making them study for long hours.

RII: As students carry these bags on their shoulders, the weight affects their growth and health.

- 7.** Bharath chose to take the stairs to his office which was on the 17th floor of the building.

RI: The elevator is not working.

RII: The building does not have an elevator.

- 8.** The Delhi High court has in a landmark judgment ordered to decriminalize homosexuality.

RI: The chief justice A.P. Shah who was one of the judges who issued the judgment is an evangelist.

RII: Equal rights should be granted to all the people in the society irrespective of their proclivities.

- 9.** China is trying to work out a new international currency with the help of the BRIC nations.

RI: China wants to insulate itself from the impact of the volatility in the value of the dollar.

RII: China wants to wage a war against America and is trying to harm America.

- 10.** Doctors have advised to people who have swine flu like symptoms stay at home till they get themselves checked.

RI: Doctors want people with swine flu to stay at home and take rest to fight the virus.

RII: As all swine flu cases have been fatal, doctors do not want to get infected with the virus.

11. Assertion:

Mr P got the Nobel Prize for Peace last year.

RI: Throughout his life, Mr P worked for the welfare of the poor and upliftment of down-trodden without any selfish motives.

RII: Mr P wrote many books on peace.

12. Assertion:

J.K. Rowling's books are selling like hot cakes.

RI: People love the subject of the book written by Rowling and the style of her writing.

RII: Rowling uses very simple language so that everyone can understand that.

13. Assertion:

Today's youth in India like western music more than Indian classical music.

RI: Western music has strong base than Indian classical music.

RII: Indian classical music is very boring and they like rocking music more.

14. Assertion:

The newly constructed bridge collapsed and caused death of many people.

RI: The design of the bridge was not proper.

RII: The bridge was constructed on black cotton soil.

15. Assertion:

The problem solving ability, mental performance and memory of the employees of company C are deteriorating.

RI: Due to tight schedule at company C, the employees of the company are skipping their breakfast regularly.

RII: The job is physical in nature, but not mental.

Directions for questions 16 to 20: In each question below, an assertion (A) is followed by a reason (R). Find the relation between the assertion and reason and mark your answers as follows:

(1) Both (A) and (R) are true and (R) is the reason for (A).

(2) Both (A) and (R) are true but (R) is not the reason for (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

16. A: Global temperatures have increased in the past decade.

R: Rise in temperature is because of pollution in the air.

17. A: Cigarette smoking is injurious to health.

R: All cigarettes contain tobacco which is harmful to health.

18. A: The government has set up awareness camps for AIDS.

R: Preventive measures are the best ways to curb the spread of AIDS as there is no definite cure for AIDS.

19. A: Summers are the hottest months in India.

R: During summer season the earth is at the farthest distance from the sun.

20. A: Tsunami occurs after every earth quake.

R: An earth quake in the floor of the sea always leads to Tsunami..

PRACTICE EXERCISE 19 (B)

Directions for questions 1 to 10: In each question below is given an Assertion followed by two reasons numbered RI and RII. Read the assertions carefully and decide which among RI/RII is/are a possible reasons.

- (1) only RI and not RII is the reason for the assertion.
- (2) only RII and not RI is the reason for the assertion.
- (3) both RI and RII are the reasons for the assertion.
- (4) neither RI nor RII is the reason for the assertion.

1. Assertion:

Every year, "Booker prize" is given by the English government to the best work in English literature.

RI. The English government has enough money with it to spend on such prizes.

RII. The English government is interested in encouraging the authors of these literary works.

2. Assertion:

Though the law warns that demanding and giving dowry are both crimes, dowry deaths are increasing in number.

RI. Demanding dowry and giving dowry is a custom in our society.

RII. The law is not a strong enough deterrent to the people who commit this crime.

3. Assertion:

Computer coaching centres are mushrooming all over India.

RI. Other than computer education, no other education is useful these days.

RII. People are opting for computer education in a big way.

4. Assertion:

The environmentalists are strongly opposed to the use of polythene bags.

RI: Polythene harms land as it never gets decomposed.

RII: Polythene bags are not made of natural products.

5. Assertion:

During polling season, new roads are constructed, there is twenty-four hours of power supply, good supply of water, and many other facilities are provided to the people.

RI: Political leaders want to be in the good books of the people.

RII: Polling season that is the right time to convert black money to white money in the name of party funds for the industrialists.

6. Assertion:

As part of its trade protectionist measures, the US government has decided to remove the tax benefits to the companies that are outsourcing work.

RI: The US government wants these companies to create more employment in the US.

RII: The US government does not want other countries to register high growth rates.

7. Assertion:

The Maharashtra government has built the Bandra Worli sea link which is the first sea link in the country.

RI: The government wants to earn money by collecting usage charges from the people who use it.

RII: The government wants to reduce the traffic and the travel time as it takes only 7 minutes to travel instead of 45 minutes.

8. Assertion:

The Indian government is planning to buy nuclear reactors from Russia.

RI: India wants to generate nuclear energy using these reactors.

RII: There is shortage of power throughout the country.

9. Assertion:

Youngsters today show an attitude of apathy towards the elderly who need their love and support.

RI: Youngsters do not have time for the old.

RII: Youngsters today only believe in an eye for an eye response to deal with people.

10. Assertion:

Ajay is planning to buy a new house in the outskirts of the city.

RI: Ajay wants to live in a peaceful environment.

RII: Ajay wants to earn money by selling the house after a year.

Directions for questions 11 to 15: In each of the following questions, an assertion is followed by two reasons, RI and RII. Read the assertion carefully and decide which between RI and RII is/are possible reason(s) for the assertion. Mark your answer as

(1) if only RI is the reason.

(2) if only RII is the reason.

(3) if either RI or RII is the reason.

(4) if neither RI nor RII is a reason.

11. Assertion: There is no life on Venus.

RI: There is no atmosphere on Venus.

RII: There are no human beings or animals on Venus.

12. Assertion: Ram closed the windows of the house.

RI: It was very hot inside.

RII: The weather outside was very cold.

13. Assertion: Mr. Venkateswarlu is suffering from cancer.

RI: He smokes cigarettes.

RII: He has been working in a cancer hospital for the last 25 years.

14. Assertion: The prices of essential commodities have risen in India.

RI: In India, the production of essential commodities has gone down due to the failure of monsoons.

RII: Despite abundant supply of essential commodities, the international prices which influence domestic prices, have shot up.

15. Assertion: Many engineering graduates are leaving the IT sector to join the real estate sector.

RI: The real estate is an ever changing and manipulative field in business.

RII: The impact of recession is seen everywhere.

Directions for questions 16 to 20: In each question below, an assertion (A) is followed by a reason (R). Find the relation between the assertion and reason and mark your answers as:

(1) if both (A) and (R) are true and (R) is the reason for (A).

- (2) if both (A) and (R) are true but (R) is not the reason for (A).
 (3) if (A) is true but (R) is false.
 (4) if (A) is false but (R) is true.
16. (A): The government suggests that all persons who are driving two wheelers should wear helmets.
 (R): A helmet protects one from outside air and UV rays.
17. (A): The forest cover is decreasing at an alarming rate.
 (R): The government has given directions to citizens to plant trees.
18. (A): Mahatma Gandhi was the first Prime Minister of India.
 (R): Mahatma Gandhi led the Satyagraha movement in India.
19. (A): India celebrates its independence day on the 15th of August.
 (R): India celebrates independence day on 15th August as its constitution came into force on this day.
20. (A): Scientists advise people to wear solar filters while viewing an eclipse.
 (R): The rays of the sun which reach the earth during an eclipse are harmful to the eye.

ANSWER KEYS

PRACTICE EXERCISE 19 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 4 | 3. 2 | 4. 3 | 5. 1 | 6. 2 | 7. 3 | 8. 2 | 9. 1 | 10. 4 |
| 11. 1 | 12. 1 | 13. 3 | 14. 1 | 15. 3 | 16. 3 | 17. 1 | 18. 1 | 19. 3 | 20. 4 |

PRACTICE EXERCISE 19 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 2 | 4. 1 | 5. 1 | 6. 1 | 7. 2 | 8. 4 | 9. 3 | 10. 3 |
| 11. 1 | 12. 2 | 13. 1 | 14. 4 | 15. 3 | 16. 3 | 17. 2 | 18. 4 | 19. 3 | 20. 1 |

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MATHEMATICS

PART 2

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Numbers and Polynomials

SYNOPSIS

Factors

When a number is expressed as a product of two or more numbers, the latter numbers are called factors. Similarly, when an algebraic expression is as the product of two or more expressions each of these later quantities is called a factor of it. The determination of these is called resolution.

Example:

- (i) $72 = 2^3 \times 2^2$
- (ii) $7a^2 - 21ab = 7a(a - 3b)$

While resolving algebraic expression the following may be remembered $x^2 + (a + b)x + ab = (x + a)(x + b)$.

Multiples

If p divides q, then p is a factor of q; and q is a multiple of p.

Co-Primes

If two numbers are such that there is no common factor other than 1, then they are said to be relatively prime or co-prime to each other.

The two numbers individually may be prime or composite.

Example: 15 and 23; 13 and 29; 15 and 32 are co-primes.

Number of Factors of a given Number

If N is a composite number such that $N = a^p \cdot b^q \cdot c^r \dots$ where a, b, c are prime factors of N and p, q, r..... are positive integers, then

- (i) the number of factors of $N = (p + 1)(q + 1)(r + 1) \dots$
For example, $144 = 2^4 \times 3^2$. Hence 144 has $(4 + 1)(2 + 1)$, i.e., 15 factors.
- (ii) The number of ways in which N can be expressed as a product of two factors = $\frac{1}{2}\{(p + 1)(q + 1)(r + 1) \dots\}$

If p, q, r etc. are all even, then the product $(p + 1)(q + 1)(r + 1) \dots$ becomes odd and the above rule will not be valid. If p, q, r,... are all even, it means that N is a perfect square.

So, to find out the number of ways in which a perfect square can be expressed as a product of 2 factors, we have the following two rules:

- (a) product of two DIFFERENT factors(excluding $\sqrt{N} \times \sqrt{N}$) is $\frac{1}{2}\{(p + 1)(q + 1)(r + 1) \dots - 1\}$ ways.
- (b) product of two factors (including $\sqrt{N} \times \sqrt{N}$) is $\frac{1}{2}\{(p + 1)(q + 1)(r + 1) \dots + 1\}$ ways.

○ LCM and HCF:

- (i) If x is a factor of y, then x is the HCF of (x, y) and y is the LCM of (x, y).
- (ii) HCF of any two consecutive even natural numbers is 2 and their LCM is half of their product.

- (iii) HCF of any two consecutive natural numbers or any two consecutive odd natural numbers is 1 and their LCM is their product.
- (iv) For any two numbers (or polynomials), product of those two numbers (or polynomials) = Product of their LCM and HCF.

Factorial

Factorial is defined for any positive integer. It is denoted by \angle or $!$. Thus “Factorial n ” is written as $n!$ or $\angle n$. $n!$ is defined as the product of all the integers from 1 to n .

Thus $n! = 1.2.3. \dots (n-1)^n$.

$0!$ is defined to be equal to 1. Therefore $0! = 1$ and $1! = 1$.

- **Surds:** If a is a positive rational number, which is not the n^{th} power (n is any natural number) of any rational number, then the irrational number $\pm \sqrt[n]{a}$ are called simple surds or monomial surds. Every surd is an irrational number (but every irrational number need not be a surd). So, the representation of monomial surd on a number line is same that of irrational numbers.

For example,

- (i) $\sqrt{3}$ is a surd and $\sqrt{3}$ is an irrational number.
- (ii) π is an irrational number, but it is not a surd.
- (iii) $\sqrt[3]{3+\sqrt{2}}$ is an irrational number. It is not a surd, because $3+\sqrt{2}$ is not a rational number.

Laws of Radicals

If $a > 0$, $b > 0$ and n is a positive rational number, then

1. $(\sqrt[n]{a})(\sqrt[n]{b}) = \sqrt[n]{ab}$
 2. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$
 3. $\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a} = \sqrt[n]{\sqrt[m]{a}}$
 4. $\sqrt[n]{a^p} = a^{\frac{p}{n}}$ and $\sqrt[n]{a^p} = \sqrt[n]{\sqrt[m]{(a^p)^m}}$.
- **Rationalizing Factor (RF):** If the product of two surds is a rational number, then each of the two is a RF of the other.
 - (i) $(\sqrt{a} + \sqrt{b})$ is the rationalising factor of $\sqrt{a} - \sqrt{b}$ and vice versa, where a and b are rational. And also $a + \sqrt{b}$ is the rationalizing factor of $a - \sqrt{b}$.

- (ii) Two surds of the form $a + \sqrt{b}$ and $a - \sqrt{b}$, are called conjugate surds. The sum and product of conjugate surds are rational numbers.

- **Square root of a quadric surd:** Consider the real number $a + \sqrt{b}$, where a and b are rational numbers and \sqrt{b} is a surd. Equate the square root of $a + \sqrt{b}$ to $\sqrt{x} + \sqrt{y}$, where x and y are rational numbers, i.e., $\sqrt{a + \sqrt{b}} = \sqrt{x} + \sqrt{y}$

Squaring both sides, $a + \sqrt{b} = x + y + 2\sqrt{xy}$

Equating the rational numbers on the two sides of the above equation we get $a = x + y$ (1)

and equating the irrational numbers, we get $\sqrt{b} = 2\sqrt{xy}$ (2)

By solving (1) and (2) we get the values of x and y .

Similarly, $\sqrt{a - \sqrt{b}} = \sqrt{x} - \sqrt{y}$

- **Square root of a trinomial quadratic surd:** Consider the real number $a + \sqrt{b} + \sqrt{c} + \sqrt{d}$, where a is a rational number and \sqrt{b}, \sqrt{c} and \sqrt{d} are surds. $\sqrt{a + \sqrt{b} + \sqrt{c} + \sqrt{d}} = \sqrt{x} + \sqrt{y} + \sqrt{z}$

By squaring both sides, and comparing rational and irrational parts on either sides, we get, $x + y + z = a$, x

$$= \frac{1}{2}\sqrt{\frac{bd}{c}}, y = \frac{1}{2}\sqrt{\frac{bc}{d}} \text{ and } z = \frac{1}{2}\sqrt{\frac{cd}{b}}$$

Remainder Theorem

When a rational integral function $f(x)$ is divided by $(x - a)$, the remainder is $f(a)$.

For example, when $x^2 - 2x + 5$ is divided by $x - 1$, the remainder will be $f(1)$, i.e., $1^2 - 2(1) + 5 = 4$

We can see that if $f(x)$ is divided by $(x + a)$, then the remainder will be $f(-a)$.

For example, when $x^3 + x^2 - 5x - 4$ is divided by $x + 1$, then the remainder will be $f(-1)$,

$$\text{i.e., } (-1)^3 + (-1)^2 - 5(-1) - 4. \text{ i.e., } 1$$

If $f(a)$ is zero, it means that the remainder is zero and hence, we can say that $(x - a)$ is a factor of $f(x)$.

- $(x - a)$ is always a factor of $x^n - a^n$
- $(x + a)$ is a factor of $x^n - a^n$ when ‘ n ’ is even
- $(x + a)$ is a factor of $(x^n + a^n)$ when n is odd.

Solved Examples

1. Find the number of factors of 324.

☞ **Solution:** $324 = 18^2 = 3^2 \times 2 \times 3^2 \times 2 = 3^4 \times 2^2$
 Number of factors = $(4 + 1)(2 + 1) = 15$.

2. Find the number of ways of expressing 216 as a product of two factors.

☞ **Solution:** 216 is not a perfect square. The number of ways of expressing any non-perfect square as a product of two factors = $\frac{1}{2}(\text{number of its factors})$
 $216 = 2^3 \times 3^3$
 Number of its factors = $(3 + 1)(3 + 1) = 16$
 \therefore The number of ways of writing 216 as a product of two factors = 8

3. Find the LCM of 216 and 240.

☞ **Solution:** $216 = 24 \times 9$ and $240 = 24 \times 10$
 L.C.M. (216, 240) = L.C.M. $(24 \times 9, 24 \times 10)$
 $= 24 \text{ L.C.M. } (9, 10) = 90$
 \therefore LCM of 216, 240 = $(24)(90) = 2160$.

4. Find the HCF of 1159 and 1769.

☞ **Solution:**

$$\begin{array}{r}
 1159)1769(1 \\
 \underline{1159} \\
 6101159(1 \\
 \underline{610} \\
 549610(1 \\
 \underline{549} \\
 61)549(9 \\
 \underline{549} \\
 0
 \end{array}$$

HCF of 1159 and 1769 = 61

5. The LCM and HCF of two natural numbers are 480 and 12 respectively. If the numbers are in the ratio 5: 8, then find the numbers.

☞ **Solution:** Let the natural numbers be $5x$ and $8x$
 HCF $(5x, 8x) = x$;
 but given HCF = 12 $\Rightarrow x = 12$
 The two numbers are
 $\therefore 5x = 60$ and $8x = 96$
 Alternately, LCM $(5x, 8x) = 40x$
 $40x = 480 \Rightarrow x = 12$
 $5x = 60$ and $8x = 96$.

6. Find the LCM of $\frac{3}{5}, \frac{4}{7}, \frac{6}{11}$

☞ **Solution:** LCM of fractions

$$= \frac{\text{LCM of numerators}}{\text{HCF of denominators}} = \frac{\text{LCM of } (3, 4, 6)}{\text{HCF of } (5, 7, 11)}$$

$$= \frac{12}{1} = 12$$

7. Find the remainder when 2^{86} is divided by 7.

☞ **Solution:** $\frac{2^{86}}{7} = \frac{2^{84} \cdot 2^2}{2^3 - 1} = \frac{(2^3)^{28} \cdot 4}{2^3 - 1}$
 By remainder theorem, if $x = 2^3$ and $f(x) = 4x^{28}$
 Required remainder = $f(1) = 4(1)^{28} = 4$.

8. Aloukya and Manoghna run in a circular track and they take 180 seconds and 150 seconds respectively to complete one revolution. If they start together at 9 am from the same point, how long it would take for them to meet again for the first time?

☞ **Solution:** The required time taken is the LCM of 180 and 150.
 $180 = 2^2 \times 3^2 \times 5^1$; $150 = 2 \times 3 \times 5^2$
 LCM = $2^2 \times 3^2 \times 5^2 = 900$ sec = 15 minutes
 They meet again for the first time at 9:15 a.m.

9. Compare the surds $A = \sqrt{8} + \sqrt{7}$ and $B = \sqrt{10} + \sqrt{5}$.

☞ **Solution:** Since there is a positive sign, squaring both the surds, we get,
 $A^2 = (\sqrt{8} + \sqrt{7})^2 = 8 + 7 + 2\sqrt{56} = 15 + 2\sqrt{56}$
 $B^2 = (\sqrt{10} + \sqrt{5})^2 = 10 + 5 + 2\sqrt{50} = 15 + 2\sqrt{50}$
 As $56 > 50$, $15 + 2\sqrt{56} > 15 + 2\sqrt{50}$
 $\Rightarrow A > B$ i.e., $\sqrt{8} + \sqrt{7} > \sqrt{10} + \sqrt{5}$

10. If both a and b are rational numbers, then find the value of a and b in the following.

$$\frac{3 + \sqrt{5}}{3 - \sqrt{5}} = a + b\sqrt{5}$$

☞ **Solution:** (i) $\frac{3 + \sqrt{5}}{3 - \sqrt{5}}$

$3 + \sqrt{5}$ is the rationalizing factor of $3 - \sqrt{5}$.

$$\begin{aligned}\therefore \frac{3+\sqrt{5}}{3-\sqrt{5}} &= \frac{3+\sqrt{5}}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}} = \frac{(3+\sqrt{5})^2}{(3)^2 - (\sqrt{5})^2} \\ &= \frac{9+5+6\sqrt{5}}{9-5} = \frac{14+6\sqrt{5}}{4} = \frac{14}{4} + \frac{6}{4}\sqrt{5} \\ &= \frac{7}{2} + \frac{3}{2}\sqrt{5} = a + b\sqrt{5} \text{ (given)}\end{aligned}$$

$$\therefore a = 7/2 \text{ and } b = 3/2$$

11. Find the square root of $7+4\sqrt{3}$.

☞ **Solution:** Let $\sqrt{7+4\sqrt{3}} = \sqrt{x} + \sqrt{y}$
 Squaring both the sides, $7+4\sqrt{3} = x+y+2\sqrt{xy}$
 $\Rightarrow x+y=7$ and $\sqrt{xy}=2\sqrt{3} = \sqrt{12}$
 $\Rightarrow xy=12$
 By solving, we get $x=4$ and $y=3$
 $\sqrt{x}+\sqrt{y}=\sqrt{4}+\sqrt{3}=2+\sqrt{3}$

12. Find the HCF and the LCM of $3a^2b^3c^4$ and $9a^4b^3c^2$.

☞ **Solution:** $3a^2b^3c^4 = (3a^2b^3c^2)c^2$ and
 $9a^4b^3c^2 = (3a^2b^3c^2)3a^2$
 The HCF of $3a^2b^3c^4$ and $9a^4b^3c^2$ is $3a^2b^3c^2$
 The LCM of $3a^2b^3c^4$ and $9a^4b^3c^2$ is $9a^4b^3c^4$

13. Find the HCF and LCM of $(x-1)(x-2)^2(x+4)^3$ and $(x+1)(x-2)(x+4)^4$.

☞ **Solution:** Clearly, the common factors of the expressions

$(x-1)(x-2)^2(x+4)^3$ and $(x+1)(x-2)(x+4)^4$ are $(x-2)$ and $(x+4)^3$.

$$\therefore \text{HCF} = (x-2)(x+4)^3 \text{ and}$$

$$\text{LCM} = (x-2)^2(x-1)(x+1)(x+4).$$

14. Find the remainder when $f(x) = x^2 + 6x + 8$ is divided by $2x + 1$.

☞ **Solution:** Given polynomial is $f(x) = x^2 + 6x + 8$ and divisor is $2x + 1$.

$$\begin{aligned}\therefore \text{Remainder} &= f\left(-\frac{1}{2}\right) = \left(-\frac{1}{2}\right)^2 + 6\left(-\frac{1}{2}\right) + 8 \\ &= \frac{1}{4} - 3 + 8 = 5\frac{1}{4}\end{aligned}$$

15. The value of $ax^2 + bx + c$ is 5 when $x = 0$. The remainder is 6 when divided by $x - 1$ and 10 when divided by $x + 1$ then find value of $5a - 2b + 5c$.

☞ **Solution:** Let $f(x) = ax^2 + bx + c$
 Given $f(0) = c = 5$ and $f(1) = a(1)^2 + b(1) + 5 = 6$
 $\Rightarrow a + b = 1$ (1)
 Also given $f(-1) = 10$, $a(-1)^2 + b(-1) + 5 = 10$
 $\Rightarrow a - b = 5$ (2)
 Solving (1) and (2) we have $2a = 6$
 $\Rightarrow a = 3$ and $b = -2$
 \therefore Value of $5a - 2b + 5c = 5(3) - 2(-2) + 5(5)$
 $= 44.$

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 50: Select the correct alternative from the given choices.

- Find the smallest and the largest three-digit numbers which when divided by 22, 33 and 55 leave a remainder of 5 in each case.
 (1) 340, 980 (2) 335, 995
 (3) 330, 990 (4) 325, 985
- The HCF of two numbers is 8. The product of the two numbers is 1536. How many pairs of such numbers satisfy the above conditions?
 (1) One (2) Two
 (3) Four (4) None of these
- Find the number of divisors of 3600 excluding one and itself.
 (1) 44 (2) 45
 (3) 47 (4) 43
- In how many ways can 2304 be written as product of two different factors?
 (1) 27 (2) 14
 (3) 13 (4) 28
- What values of n satisfy the following statements (given n is a natural number)?
 (a) $2^{3n} - 1$ is divisible by 7
 (1) Even values of n
 (2) Odd values of n
 (3) All values of n
 (4) Cannot say
- $5^n + 1$ is divisible by 6
 (1) Even values of n (2) Odd values of n
 (3) All values of n (4) Cannot say
- Find the value of a if the expression $3x^2 + ax - 7$ is divisible by $(x - 1)$.
 (1) -4 (2) 4
 (3) 10 (4) -10
- What is the remainder when 2^{63} is divided by 7?
 (1) 2 (2) 4
 (3) 1 (4) 5
- What is the remainder when 5^{68} is divided by 8?
 (1) 5 (2) 1
 (3) 4 (4) 3
- Find the highest power of 2 contained in 150!
 (1) 148 (2) 146
 (3) 147 (4) 145
- The sum of the first N natural numbers is equal to x^2 where x is an integer less than 100. What are the values that N can take?
 (1) 1, 9, 27
 (2) 1, 7, 26
 (3) 1, 8, 48
 (4) 1, 8, 49
- The LCM of two numbers is 1200. Which of the following cannot be their HCF?
 (1) 600 (2) 500
 (3) 200 (4) 400
- Find the units digit of $(12)^{3^x} + (18)^{3^x}$ for all $x \in \mathbb{N}$.
 (1) 0 (2) 4
 (3) 2 (4) 3
- The LCM and the HCF of two numbers are 144 and 12 respectively. How many such pairs of numbers are possible?
 (1) 2 (2) 3
 (3) 4 (4) 5
- P is the LCM of 2, 4, 6, 8, 10. Q is the LCM of 1, 3, 5, 7, 9. L is the LCM of P and Q . Find the relation between L and P .
 (1) $L = P$
 (2) $L = 2P$
 (3) $L = 21P$
 (4) $L = 60P$
- Find the sum up to 91 terms of the following

$$\frac{1}{\sqrt{9} + \sqrt{10}} + \frac{1}{\sqrt{10} + \sqrt{11}} + \frac{1}{\sqrt{11} + \sqrt{12}} + \dots$$

 (1) 90 (2) 10
 (3) 7 (4) 1
- Ashok had two vessels which contain 720 ml and 405 ml of milk respectively. Milk in each vessel was poured into glasses of equal capacity to their brim. Find the minimum number of glasses which can be filled with milk.
 (1) 15 (2) 20
 (3) 25 (4) 30

18. If m is a real number, then the simplified form of the expression $(m^{-16} \div m^{-8} \div m^{-6} \div m^{-4})$ is ____.

- (1) 1 (2) m
(3) m^{-2} (4) m^2

19. If $a^m = b^m$, then ____ ($m > 0$).

- (1) $a = -b$
(2) $a = b$
(3) $2a + b = 0$
(4) $a^2 = b^2$

20. Simplify: $\left[\frac{(x+y)^{-1} \cdot (x-y)^{-m}}{(x+y)^{m+n} \cdot (x-y)^{1+n}} \right] (x^2 - y^2)^{1+m+n}$

(where $x \neq y$ and $x + y \neq 0$)

- (1) x^2 (2) x
(3) 0 (4) 1

21. If $ab = x^2$, $bc = y^2$ and $ca = z^2$, then find the value of

$\left(\frac{abc}{xyz} \right)^{xyz}$, where xyz is an integer.

- (1) 1 (2) -1
(3) ± 1 (4) 0

22. Greatest among $\sqrt[6]{7}$, $\sqrt[4]{5}$, $\sqrt[5]{6}$, $\sqrt[6]{8}$ is

- (1) $\sqrt[6]{7}$ (2) $\sqrt[4]{5}$
(3) $\sqrt[5]{6}$ (4) $\sqrt[6]{8}$

23. If $x = 5 + 2\sqrt{6}$ and $y = 5 - 2\sqrt{6}$, then find the value of $1/x^2 + 1/y^2$.

- (1) 1 (2) 100
(3) 96 (4) 98

24. Simplify: $\sqrt[6]{15 - 2\sqrt{56}} \sqrt[3]{\sqrt{7} + 2\sqrt{2}}$

- (1) 8 (2) 7
(3) 2 (4) 1

25. If $p = 7 - 4\sqrt{3}$, then find the value of $\frac{p^2 + 1}{7p}$.

- (1) 1 (2) 2
(3) 3 (4) 4

26. $(5^{1/3} + 5^{-1/3})(5^{2/3} - 1 + 5^{-2/3}) =$ ____.

- (1) 6 (2) 5
(3) $26/5$ (4) $41/5$

27. If $\sqrt{12 + x\sqrt{2}} = 2\sqrt{2} - 2$, then find x .

- (1) 6 (2) 8
(3) -8 (4) -6

28. Simplify: $\sqrt[3]{2^x} \sqrt[2]{3^{x^3}} \sqrt[4]{6^{x^6}} \sqrt[5]{9^{x^{10}}}$

- (1) 2 (2) 3
(3) 12 (4) 18

29. If the HCF of the polynomials $f(x)$ and $g(x)$ is $4x - 6$, then $f(x)$ and $g(x)$ could be ____.

- (1) $2, 2x - 3$ (2) $8x - 12, 2$
(3) $2(2x - 3)^2, 4(2x - 3)$ (4) $2(2x + 3), 4(2x + 3)$

30. The LCM of the polynomials $15a^2b(a^2 - b^2)$ and $40ab^2(a - b)$ is ____.

- (1) $120ab(a^2 - b^2)$ (2) $120a^2b^2(a^2 - b^2)$
(3) $5a^2b^2(a^2 - b^2)$ (4) $120ab(a - b)$

31. Find the HCF of $(x^2 - 4)$, $(x^2 - x - 2)$ and $(x^2 + 4x + 4)$ ($x^2 - 3x + 2$).

- (1) $x^2 - 4$ (2) $(x + 2)^2$
(3) $(x - 2)^2$ (4) $x^2 - 1$

32. If $f(x) = (x - 2)(x^2 - x - a)$, $g(x) = (x + 2)(x^2 + x - b)$ and their HCF is $x^2 - 4$, then find $a - b$. (a and b are constants)

- (1) 0 (2) 4
(3) 1 (4) 6

33. If the LCM of $f(x) = (x + 1)^5(x + 2)^a$ and $g(x) = (x + 1)^b(x + 2)^a$ is $(x + 1)^a(x + 2)^b$, then find the minimum value of $a + b$.

- (1) 5 (2) 8
(3) 10 (4) 12

34. $\frac{2x}{1 + x^2 + x^4} + \frac{1}{1 + x + x^2} - \frac{1}{1 - x + x^2} =$

- (1) $2x$ (2) x
(3) 1 (4) 0

35. If degree of each of $f(x)$ and $[f(x) + g(x)]$ is 18, then find the range of degree of $g(x)$.

- (1) 18 (2) ≥ 18
(3) ≤ 18 (4) can't say

36. Find the product of additive inverse and multiplicative inverse of $(x - 2)/(x^2 - 4)$.

- (1) $x + 2$ (2) $x - 2$
(3) 1 (4) -1

37. If $f(x + 2) = x^2 + 7x - 13$, then find the remainder when $f(x)$ is divided by $(x + 2)$.

- (1) -25 (2) -12
(3) -23 (4) -11

38. If $ax^3 - 5x^2 + x + p$ is divisible by $x^2 - 3x + 2$, then find the values of a and p .
- (1) $a = 2, p = 2$ (2) $a = 2, p = 3$
 (3) $a = 3, p = 1$ (4) $a = 1, p = 3$
39. If the polynomials $f(x) = x^2 + 5x - p$ and $g(x) = x^2 - 2x + 6p$ have a common factor, then the common factor is ____.
- (1) $x + 2$ (2) x
 (3) $x + 4$ (4) Either (2) or (3)
40. Given $f(x)$ is a cubic polynomial in x . If $f(x)$ is divided by $(x + 3)$, $(x + 4)$, $(x + 5)$ and $(x + 6)$, then it leaves the remainders 0, 0, 4 and 6 respectively. Find the remainder when $f(x)$ is divided by $x + 7$.
- (1) 0 (2) 1
 (3) 2 (4) 3
41. What is the largest number which divides 206, 368 and 449 and leaves the same remainder in each case?
- (1) 32 (2) 48
 (3) 81 (4) 96
42. $N = 161^3 - 77^3 - 84^3$, which of the following statements is not true?
- (1) N is divisible by 4 and 23.
 (2) N is divisible by 23 and 11.
 (3) N is divisible by 4 and 7.
 (4) N is divisible by 8 and 11.
43. Find the last digit of $1567^{143} \times 1239^{197} \times 2566^{1027}$.
- (1) 2 (2) 3
 (3) 4 (4) 6
44. If x is a composite number, which of the following is necessarily true?
- (1) There is at most one factor of x (say a) such that $0 < a < \sqrt{x}$.
 (2) There are at least two factors x (say a and b) such that $0 < a < \sqrt{x}$ and $0 < b < \sqrt{x}$.
 (3) There are at least 4 factors of x .
 (4) If, there are 3 factors not greater than \sqrt{x} , then there are 3 factors not less than \sqrt{x} .
45. Find the remainder when $1! + 2! + 3! + 4! + 5! + \dots + 49!$ is divided by 7.
- (1) 0 (2) 1
 (3) 5 (4) 6
46. A sweet shop sells laddus in boxes of different sizes. The laddus are priced at ₹10 per laddu upto 400 laddus. For every 10 additional laddus, the price of the entire lot goes down by 10 paise per laddu. Find the size of the box that would have the maximum cost.
- (1) 600 (2) 500
 (3) 700 (4) 800
47. When a natural number, N is divided by D , the remainder is 35. When $50N$ is divided by D , the remainder is 11. Find D .
- (1) 1739 (2) 43
 (3) 47 (4) Cannot be determined
48. If $\text{LCM}(P, Q, R) = (P)(Q)(R)$, then $\text{HCF}(P, R) =$
- (1) 1 (2) 2
 (3) Q (4) Cannot say
49. How many numbers less than 2^{24} are co prime to it?
- (1) 2^{12} (2) 2^{23}
 (3) 2^{22} (4) None of these
50. A number when divided by 48 leaves a remainder of 31. Find the remainder if the same number is divided by 24.
- (1) 5 (2) 7
 (3) 9 (4) 11

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 50: Select the correct alternative from the given choices.

1. How many integers between 400 and 900 are exactly divisible by 2, 3 and 7?
- (1) 10 (2) 11
 (3) 12 (4) 13

2. Find the smallest and the largest four-digit numbers which when lessened by 12 are exactly divisible by 16, 24 and 40.
- (1) 1208, 9848
 (2) 1200, 9840
 (3) 1212, 9852
 (4) 1188, 9828

3. What is the remainder when 3^{21684} is divided by 5?
 (1) 4 (2) 1
 (3) 2 (4) 3
4. The product of two numbers whose HCF is 18 is 5832. How many pairs of numbers satisfy the above conditions?
 (1) One (2) Two
 (3) Three (4) None of these
5. Find the number of factors of 1728.
 (1) 28 (2) 18
 (3) 36 (4) 26
6. In how many ways can 2744 be resolved as a product of two factors?
 (1) 16 (2) 14
 (3) 6 (4) 8
7. For what values of n , is true (where n is a natural number)? the following statements are $5^n + 4^n$ is divisible by 9
 (1) All values of n (2) Even values of n
 (3) Odd values of n (4) Cannot say
8. $18^n - 2^{4n}$ is divisible by 34
 (1) All values of n (2) Even values of n
 (3) Odd values of n (4) No value
9. Find the highest power of 3 contained in 120!
 (1) 57 (2) 60
 (3) 59 (4) 58
10. A number when divided by a certain divisor leaves a remainder of 12. What is the divisor if a remainder of 9 is left when thrice the same number is divided by the same divisor?
 (1) 18 (2) 24
 (3) 27 (4) 30
11. If x and y are irrational numbers, then $x + y - xy$ is
 (1) a real number
 (2) a complex number
 (3) a rational number
 (4) an irrational number
12. If $64 = x^y$, where $x > y$, $x \neq 4$ and $y \neq 1$, then $x + y =$
 (1) 7 (2) 4
 (3) 8 (4) 10
13. Two positive numbers have their HCF as 12 and their sum is 84. Find the number of pairs possible for the numbers.
 (1) 4 (2) 3
 (3) 2 (4) 1
14. If $X = 28 + (1 \times 2 \times 3 \times 4 \times \dots \times 16 \times 28)$ and $Y = 17 + (1 \times 2 \times 3 \times \dots \times 17)$, then $X - Y$ is a
 (1) Prime (2) Composite
 (3) 1 (4) 0
15. There are 144 boys and 132 girls in a class. These students are arranged in rows for prayer in such a way that each row has either boys or girls, and every row has an equal number of students. Find the minimum number of rows in which all the students can be arranged.
 (1) 12 (2) 20
 (3) 23 (4) 24
16. If $a = \sqrt{11} + \sqrt{3}$, $b = \sqrt{12} + \sqrt{2}$ and $c = \sqrt{17} - \sqrt{3}$, then arrange them in descending order.
 (1) $a < b < c$ (2) $a > b < c$
 (3) $a = b = c$ (4) $a > b > c$
17. Find the remainder when the square of any prime number greater than 3 is divided by 6.
 (1) 1 (2) 2
 (3) 3 (4) 5
18. If $x = 1/12$, which is the greatest among x^{-1} , x^2 and $2/x$?
 (1) x^{-1} (2) x^2
 (3) $2/x$ (4) All are equal
19. If $3^m \times 2^n = 18 \times 9 \times 27$, then $3^m/3^{2n} =$ _____.
 (1) 243 (2) 192
 (3) 125 (4) 81
20. If $\left(\frac{9}{4}\right)^{x+y} = \left(\frac{3}{2}\right)^{16}$ and $\left(\frac{49}{64}\right)^{x-2y} = \left(\frac{7}{8}\right)^4$, then $xy =$
 (1) 12 (2) 14
 (3) 15 (4) 16
21. If $x^5 + 1 = 7777$ and $y^4 - 1 = 9999$, then find the value of xy , where both x and y are positive integers.
 (1) 70 (2) 60
 (3) 80 (4) 40
22. If $x = 2 + 2^{\frac{1}{3}} + 2^{\frac{2}{3}}$, then prove that $x^3 - 6x^2 + 6x =$
 (1) 0 (2) 2
 (3) 1 (4) 6
23. Simplify: $\sqrt{7+2\sqrt{6}} - \sqrt{7-2\sqrt{6}}$
 (1) $2\sqrt{6}$ (2) 1
 (3) 2 (4) 14

24. If $x = \frac{1}{5+2\sqrt{6}}$, then find the value of $x^2 - 10x =$.

- (1) 0 (2) 1
(3) -1 (4) 5

25. The smallest rationalizing factor of $\sqrt[3]{63}$ is ____.

- (1) $\sqrt[3]{37}$ (2) $\sqrt[3]{62}$
(3) $\sqrt[3]{147}$ (4) $\sqrt[3]{243}$

26. $\left[\frac{3}{\sqrt{19-2\sqrt{88}}} - \frac{8}{\sqrt{14+2\sqrt{33}}} \right] \cdot (\sqrt{8} - \sqrt{3}) =$

- (1) $\sqrt{5}$ (2) $\sqrt{8}$
(3) -3 (4) 5

27. If $x^{3a} = y^{2b} = z^{4c} = xyz$, then $3ab + 4bc + 6ca =$

- (1) $3abc$ (2) $8abc$
(3) $9abc$ (4) $12abc$

28. The LCM of $x^2 - 1$, $x^2 + 1$ and $x^4 - 1$ is ____.

- (1) $(x^2 + 1)(x^2 - 1)$ (2) $(x + 1)^2(x - 1)^2$
(3) $(x + 1)^2(x - 1)$ (4) None of these

29. The product of the HCF and the LCM of two polynomials is $(x^2 - 1)(x^4 - 1)$, then the product of the polynomials is ____.

- (1) $(x^2 - 1)(x^2 + 1)$ (2) $(x^2 - 1)(x^2 + 1)^2$
(3) $(x^2 - 1)^2(x^2 + 1)$ (4) None of these

30. If the LCM of $(x^2 + 3x)(x^2 + 3x + 2)$ and $(x^2 + 6x + 8)(x^2 + kx + 6)$ is $x(x + 1)(x + 2)^2(x + 3)(x + 4)$, then find k .

- (1) 2 (2) 3
(3) 5 (4) 8

31. If the LCM of $f(x)$ and $g(x)$ is $6x^2 + 13x + 6$ and their HCF is a linear polynomial, find the possible HCF of $f(x)$ and $g(x)$.

- (1) $2x - 3$ (2) $3x + 2$
(3) $3x - 2$ (4) $3x + 4$

32. If $(x + 6)$ is the HCF of $p(x) = x^2 - a$ and $q(x) = x^2 - bx + 6$, then $\frac{p(x)}{q(x)}$ in its lowest terms is ____.

- (1) $\frac{x-6}{x-2}$ (2) $\frac{x+6}{x+1}$
(3) $\frac{x-6}{x-1}$ (4) $\frac{x-6}{x+1}$

33. If $f(x) = (x + 2)(x^2 + 8x + 15)$ and $g(x) = (x + 3)(x^2 + 9x + 20)$, then find the HCF of $f(x)$ and $g(x)$.

- (1) $x + 3$ (2) $x^2 + 8x + 15$
(3) $x + 4$ (4) $x^2 + 9x + 20$

34. The LCM of $12x^3y^2$ and $18x^4y^3$ is $36x^4y^3$. Find the number of integer values possible for p .

- (1) 1 (2) 2
(3) 3 (4) 4

35. Simplify: $\frac{a^2 - (b - c)^2}{(a + c)^2 - b^2} + \frac{b^2 - (a - c)^2}{(a + b)^2 - c^2} + \frac{c^2 - (a - b)^2}{(b + c)^2 - a^2}$.

- (1) 1 (2) $a - b - c$
(3) $a + b + c$ (4) 0

36. If x^5 is divided by $x^2 - 4x + 3$, then find its remainder.

- (1) $121x + 120$ (2) $121x - 120$
(3) $120x + 121$ (4) $120x - 121$

37. The remainder obtained when $2x^4 + 3x^2 - 2$ is divided by $x^2 + 2$ is ____.

- (1) 0 (2) 12
(3) 14 (4) 16

38. Which of the following should be added to $9x^3 + 6x^2 + x + 2$ so that the sum is divisible by $(3x + 1)$?

- (1) -4 (2) -3
(3) -2 (4) -1

39. Which of the following is/are factors of $x^3 + 3x^2 - x - 3$?

- (a) $x + 1$ (b) $x - 1$
(c) $x + 3$
(1) Only (a) (2) Only (b)
(3) Both (a) and (b) (4) All (a), (b) and (c)

40. If $(x - 2)$ and $(x - 3)$ are two factors of $x^3 + ax + b$, then find the remainder when $x^3 + ax + b$ is divided by $x - 5$.

- (1) 0 (2) 15
(3) 30 (4) 60

41. The sets S_x are defined to be $(x, x + 1, x + 2, x + 3, x + 4)$ where $x = 1, 2, 3, \dots, 80$. How many of these sets contain 6 or its multiple?

- (1) 65 (2) 66
(3) 59 (4) 60

42. $N = (4711)(4713)(4715)$. Find the remainder when N is divided by 48.

- (1) 19 (2) 21
(3) 17 (4) 23

43. What is the minimum number of identical square tiles required to completely cover a floor of dimensions 8 m 70 cm by 6 m 38 cm?

- (1) 143 (2) 165
(3) 187 (4) 209
44. What is the last digit of $518^{163} + 142^{157}$?
(1) 2 (2) 4
(3) 6 (4) 8
45. Ravi distributed the chocolates with him equally between Rajesh and Suresh. He was left with a chocolate. Rajesh distributed his share equally among three of his friends and was also left with a chocolate. One of the three distributed his share equally among four of his friends and was left with no chocolate. Which of the following could be the number of chocolates that Rajesh received?
(1) 22 (2) 34
(3) 49 (4) 64
46. $(AB)^2 = CCB$ where A, B and C are distinct single-digit natural numbers and 'AB' and 'CCB' are two-digit and three-digit natural numbers respectively. Find the number of possibilities for AB.
(1) 0 (2) 1
(3) 2 (4) 3
47. If $N = 1223334444\dots$ and is a 100-digit number, find the remainder when N is divided by 16.
(1) 15 (2) 13
(3) 11 (4) 9
48. $\frac{1}{3^2-1} + \frac{1}{5^2-1} + \frac{1}{7^2-1} + \dots + \frac{1}{35^2-1} =$
(1) $\frac{4}{17}$ (2) $\frac{17}{72}$
(3) $\frac{19}{72}$ (4) $\frac{17}{36}$
49. If $N = 2^a \times 3^b \times 5^c$, how many numbers (in terms of N) are less than N and are co prime to it?
(1) $\frac{2}{15}N$ (2) $\frac{4}{15}N$
(3) $\frac{8}{15}N$ (4) $\frac{2}{5}N$
50. A number when divided by 18 leaves a remainder of 15. Which of the following could be the remainder when it is divided by 72?
(1) 33 (2) 51
(3) 15 (4) All the above

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 4 | 4. 3 | 5. 3 | 6. 2 | 7. 2 | 8. 3 | 9. 2 | 10. 2 |
| 11. 4 | 12. 2 | 13. 1 | 14. 1 | 15. 3 | 16. 3 | 17. 3 | 18. 4 | 19. 4 | 20. 4 |
| 21. 3 | 22. 2 | 23. 4 | 24. 4 | 25. 2 | 26. 3 | 27. 3 | 28. 4 | 29. 3 | 30. 2 |
| 31. 1 | 32. 1 | 33. 3 | 34. 4 | 35. 3 | 36. 4 | 37. 1 | 38. 1 | 39. 4 | 40. 1 |
| 41. 3 | 42. 4 | 43. 1 | 44. 4 | 45. 3 | 46. 3 | 47. 4 | 48. 1 | 49. 2 | 50. 2 |

PRACTICE EXERCISE 1 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 2 | 4. 2 | 5. 1 | 6. 4 | 7. 3 | 8. 2 | 9. 4 | 10. 3 |
| 11. 1 | 12. 4 | 13. 2 | 14. 2 | 15. 3 | 16. 4 | 17. 1 | 18. 3 | 19. 1 | 20. 1 |
| 21. 2 | 22. 2 | 23. 1 | 24. 3 | 25. 3 | 26. 4 | 27. 4 | 28. 1 | 29. 3 | 30. 3 |
| 31. 2 | 32. 4 | 33. 2 | 34. 1 | 35. 1 | 36. 2 | 37. 1 | 38. 3 | 39. 3 | 40. 4 |
| 41. 2 | 42. 2 | 43. 2 | 44. 2 | 45. 3 | 46. 3 | 47. 4 | 48. 2 | 49. 2 | 50. 4 |

Equations and Inequalities

SYNOPSIS

- **Equation:** An open sentence which contains equality sign (=) is called an equation. A first degree equation is called a linear equation and the second degree equation is called quadratic equation.

- **Simultaneous Linear Equations:** When we consider two or more linear equations, we need to find the values of the unknowns that satisfy all the given equations. Since the values satisfy all the given equations we call them simultaneous equations.

Let us consider the equations, $2x + 5y = 19$, and $5x - 2y = 4$.

Both the equations are satisfied by the same values of $x = 2$ and $y = 3$. Thus we can say that when two or more equations are satisfied by the same values of unknown quantities then those equations are called simultaneous equations.

- **Nature of solutions:** When we try to solve a pair of equations we could arrive at three possible results. They are, having a unique solution, an infinite number of solutions or no solution.

Let the pair of equations be $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, where a_1 and b_1 are the coefficients of x ; b_1 and b_2 are the coefficients of y ; while c_1 and c_2 are the known constant quantities.

- (a) If $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, then the pair of equations will have a unique solution.

- (b) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$, then $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ will have infinite solutions.

For example, $3x + 4y = 8$; $9x + 12y = 24$.

For these two equations $a_1 = 3$, $a_2 = 9$, $b_1 = 4$, $b_2 = 12$, $c_1 = -8$, $c_2 = -24$

$$\therefore \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}. \text{ Since, } \frac{3}{9} = \frac{4}{12} = \frac{-8}{-24}, \text{ the pair}$$

of equations will have infinite solutions.

- (c) A pair of equations having no solution at all:

If $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$, then $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ will have no solution.

Note:

1. In other words, the two equations will contradict each other or be inconsistent with each other.
2. A pair of equations is said to be consistent if it has a solution (finite (independent) or infinite (dependent)).

Inequalities: If a is any real number, then a is either positive or negative or zero. When a is positive, we write $a > 0$, which is read as 'a is greater than zero'. When a is negative, we write $a < 0$, which is read as 'a is less than zero'. If a is zero, we write $a = 0$ and in this case, a is neither positive nor negative.

Properties

- For any two real numbers a and b , either $a > b$ or $a < b$ or $a = b$. (Law of Trichotomy).
- If $a > b$, then $b < a$.
- If $a > b$ and $b > c$, then $a > c$. (Transitive property).
- If $a > b$ then $a + c > b + c$.
- If $a > b$ and $c > 0$, then $ac > bc$.
- If $a > b$ and $c < 0$, then $ac < bc$.
- If $a > b$ and $c > d$, then $a + c > b + d$.
- The square of any real number is always greater than or equal to 0.
- If $a > 0$, then $-a < 0$ and if $a > b$, then $-a < -b$.
- If a and b are positive numbers and $a > b$, then $1/a < 1/b$.
- If a and b are negative numbers and $a > b$, then $1/a < 1/b$.
- If $a > 0$ and $b < 0$, then $1/a > 1/b$.

Inequation: An open sentence which consists of one of the symbols viz., $>$, $<$, \geq , \leq is called an inequation.

For example, $3x - 8 > 8$, $2x - 5 < 0$, $x^2 \geq 0$

Continued inequation: Two inequations of the same type (i.e., both consisting of $>$ or \geq or both consisting of $<$ or \leq) can be combined into a continued inequation as explained below.

Example: If $a < b$ and $b < c$, we can write $a < b < c$. If $a \geq b$ and $b > c$, we can write $a \geq b > c$.

Linear inequation: An inequation in which the highest degree of the variables present is one is called a linear inequation.

Example:

- (i) $3x + 4 \leq 8 - 3x$ and $8x - 64 \geq 8 + 5y$ are some of the examples for linear inequations.
- (ii) $5x^2 + 6 > 7$ and $6x^3 + 6y^3 \leq 8$ are some of the examples for non-linear inequations.
- **Absolute value:** If a is any real number, then
 - (i) $|x| \leq a \Rightarrow -a \leq x \leq a$; (ii) $|x| \geq a \Rightarrow x \geq a$ or $x \leq -a$

Properties of Modulus

- (1) $x = 0 \Leftrightarrow |x| = 0$;
- (2) For all values of x , $|x| \geq 0$ and $-|x| \leq 0$
- (3) For all values of x , $|x + y| \leq |x| + |y|$
- (4) $|x| - |y| \leq |x - y|$
- (5) $-|x| \leq x \leq |x|$
- (6) $|xy| = |x| |y|$
- (7) $\left| \frac{x}{y} \right| = \frac{|x|}{|y|}$, $y \neq 0$
- (8) $|x|^2 = x^2$

- **Interval Notation:** If the solution set or the range of values that satisfy inequalities are not discrete, such ranges can be represented using the interval notation.

The set of all real numbers between a and b (where $a < b$) excluding a and b is represented as (a, b) read as “the open interval a, b ”. $[a, b]$ read as “the closed interval a, b ” means all real numbers between a and b including a and b ($a < b$).

$[a, b)$ means all numbers between a and b , with a being included and b excluded ($a < b$).

Quadratic Equations

A quadratic equation is a second degree polynomial in x usually equated to zero. In other words, for an equation to be a quadratic, the coefficient of x^2 should not be zero and the coefficients of any higher power of x should be 0.

For example, $x^2 - 5x + 6 = 0$ is a quadratic equation in x .

- **Roots of the equation:** Just as a first degree equation in x has one value of x satisfying the equation, a quadratic equation in x has two values (in some cases the two values may be equal) of x that satisfy the equation. The values of x that satisfy the equation are called the **ROOTS** of the equation. These roots may be real or complex, equal or distinct.

For example,

The roots of $x^2 - 5x + 6 = 0$ are $x = 2$ and $x = 3$

- **Nature of the roots:** The roots of a quadratic equation with real coefficients can be real or complex. When the roots are real, they can be rational or irrational and, also, they can be equal or unequal.

Consider the expression $b^2 - 4ac$. Since $b^2 - 4ac$ determines the nature of the roots of the quadratic equation, it is called the “**DISCRIMINANT**” of the quadratic equation.

The following table gives us a clear idea about the nature of the roots of a quadratic equation when a , b and c are all rational.

Condition	Nature of roots
When $b^2 - 4ac < 0$,	the roots are complex conjugates.
When $b^2 - 4ac = 0$,	the roots are rational and equal.
When $b^2 - 4ac > 0$ and a perfect square,	the roots are rational and unequal.
When $b^2 - 4ac > 0$ and not a perfect square,	the roots are irrational and unequal.

Note:

Whenever the roots of the quadratic equation are irrational, (a, b, c being rational), are of the form $a + \sqrt{b}$ and $a - \sqrt{b}$. If the roots of a quadratic equation are irrational, then they are conjugate to each other.

○ **Constructing a new quadratic equation by changing the roots of a given quadratic equation:**

Consider the quadratic equation $ax^2 + bx + c = 0$ and let its roots be α and β .

- (i) A quadratic equation whose roots are $1/\alpha$ and $1/\beta$, i.e., the roots are reciprocal to the roots of the given quadratic equation can be obtained by substituting $(1/x)$ for x in the given equation, which gives us $cx^2 + bx + a = 0$, i.e., we get the equation required by interchanging the coefficient of x^2 and the constant term.
- (ii) A quadratic equation whose roots are $(\alpha + k)$ and $(\beta + k)$ can be obtained by substituting $(x - k)$ for x in the given equation.
- (iii) A quadratic equation whose roots are $(\alpha - k)$ and $(\beta - k)$ can be obtained by substituting $(x + k)$ for x in the given equation.
- (iv) A quadratic equation whose roots are $(k\alpha)$ and $(k\beta)$ can be obtained by substituting with (x/k) for x in the given equation.
- (v) A quadratic equation whose roots are (α/k) and (β/k) can be obtained by substituting (kx) for x in the given equation.
- (vi) A quadratic equation whose roots are $(-\alpha)$ and $(-\beta)$ can be obtained by replacing x by $(-x)$ in the given equation.

Maximum or Minimum Value of a Quadratic Expression

The quadratic expression $ax^2 + bx + c$ takes different values as x takes different values.

For all the values of x , as x varies from $-\infty$ to $+\infty$, (i.e., when x is real), the quadratic expression $ax^2 + bx + c$

- (i) has a minimum value if $a > 0$ (i.e., a is positive). The minimum value of the quadratic expression is $\frac{(4ac - b^2)}{4a}$ and it occurs at $x = \frac{-b}{2a}$.
- (ii) has a maximum value if $a < 0$ (i.e., a is negative). The maximum value of the quadratic expression is $\frac{(4ac - b^2)}{4a}$ and it occurs at $x = \frac{-b}{2a}$.

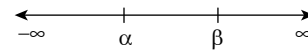
Quadratic Inequalities

Consider the quadratic equation $ax^2 + bx + c = 0$, ($a \neq 0$) where a, b and c are real numbers. The quadratic inequalities related to $ax^2 + bx + c = 0$ are $ax^2 + bx + c < 0$ and $ax^2 + bx + c > 0$. Assume that $a > 0$. The following cases arise:

Case (i): If $b^2 - 4ac > 0$, then the equation $ax^2 + bx + c = 0$ has real and unequal roots.

Let α and β ($\alpha < \beta$) be the roots. Then,

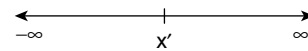
$$\therefore ax^2 + bx + c = a(x - \alpha)(x - \beta)$$



- (a) If $x < \alpha$, then $(x - \alpha) < 0$ and $(x - \beta) < 0$.
 $\therefore ax^2 + bx + c > 0$
- (b) If $\alpha < x < \beta$, then $(x - \alpha) > 0$ and $(x - \beta) < 0$.
 $\therefore ax^2 + bx + c < 0$
- (c) If $x > \beta$, then $x - \alpha > 0$ and $x - \beta > 0$.
 $\therefore ax^2 + bx + c > 0$

Case (ii): If $b^2 - 4ac = 0$, then $ax^2 + bx + c = 0$ has real and equal roots.

Let x' be the equal root $\Rightarrow ax^2 + bx + c = a(x - x')(x - x')$



- (a) If $x < x'$. Then $x - x' < 0$. $\therefore ax^2 + bx + c > 0$
- (b) If $x > x'$, then $x - x' > 0$. $\therefore ax^2 + bx + c > 0$

Case (iii): If $b^2 - 4ac < 0$, then $ax^2 + bx + c = 0$ has imaginary roots.

In this case, $ax^2 + bx + c > 0, \forall x \in \mathbb{R}$.

The above concept can be summarized as

- (i) If $\alpha < x < \beta$, then $(x - \alpha)(x - \beta) < 0$ and vice-versa.
- (ii) If $x < \alpha$ and $x > \beta$ ($\alpha < \beta$), then $(x - \alpha)(x - \beta) > 0$ and vice-versa.

Note:

If $a < 0$ and $b^2 - 4ac < 0$ then the solution for $ax^2 + bx + c > 0$ does not exist.

Solved Examples

1. Solve $3x + 7y = 32$ and $7x + 3y = 48$.

☞ **Solution:** Given, $3x + 7y = 32$ (1);
 $7x + 3y = 48$ (2)

Step 1: Adding both the equations, we get
 $10x + 10y = 80 \Rightarrow 10(x + y) = 10 \times 8$
 $\Rightarrow x + y = 8$ (3)

Step 2: Subtracting equation (1) from equation (2), $(7x + 3y) - (3x + 7y) = 48 - 32$
 $\Rightarrow 4x - 4y = 16 \Rightarrow 4(x - y) = 4 \times 4 \Rightarrow x - y = 4$ (4)

Step 3: Adding the equations (3) and (4),
 $x + y + x - y = 12 \Rightarrow 2x = 12 \Rightarrow x = 6$
 Substituting $x = 6$ in any of the equations (1), (2), (3) or (4), we get, $y = 2$
 \therefore The solution of the pair of equations is $x = 6; y = 2$.

2. The sum of the digits of a two digit number is 8. If 18 is added to the number, then the resultant number is equal to the number obtained by reversing the digits of the original number. Find the original number.

☞ **Solution:** Let the number be in the form of $10x + y$, where x and y are the tens digit and the units digit respectively. Applying the first condition, we get $x + y = 8$ (1)
 Applying the second condition, given in the problem,

$$10x + y + 18 = 10y + x \Rightarrow 9x - 9y = -18$$

$$\Rightarrow x - y = -2$$
 (2)

By solving equations (1) and (2), we get, $x = 3$ and $y = 5$ and the number is 35.

3. Four years ago, age of a person was 4 times that of his son. Six years later, the age of the person will be 10 years less than thrice the age of his son. Find the present ages of the person and his son.

☞ **Solution:** Let the present ages of the person and his son be x years and y years respectively.

Given, $x - 4 = 4(y - 4)$
 $\Rightarrow x - 4 = 4y - 16 \Rightarrow x - 4y = -12$ (1)

And also given, $x + 6 = 3(y + 6) - 10$
 $\Rightarrow x + 6 = 3y + 8 \Rightarrow x - 3y = 2$ (2)

By solving the equations (1) and (2), we get $x = 44$ and $y = 14$

4. A father's present age is seven years less than 30 times of what his son's age was 20 years ago. Also, the father's present age is 31 years more than his son's present age. Find the sum of their present ages, in years.

☞ **Solution:** Let the present age of father be f years.
 Let sons present age be s years.
 Then $f = 30(s - 20) - 7$ (1);
 $f = s + 31$ (2)
 $s + 31 = 30s - 600 - 7 \Rightarrow 638 = 29s$
 $\Rightarrow 22 = s$

$$\Rightarrow f = 53$$

The sum of their ages = 75 years.

5. Find the values of a for which the following system of equations has exactly one solution. $2x + ay = 11$, $ax + 8y = 21$.

☞ **Solution:** Here, $a_1 = 2$, $a_2 = a$, $b_1 = a$ and $b_2 = 8$.
 Now $a_1 b_2 - a_2 b_1 = 16 - a^2$. For the given system to have exactly one solution, $16 - a^2 \neq 0 \Rightarrow a^2 \neq 16 \Rightarrow a \neq \pm 4$. $\therefore a$ can be any real number except ± 4 .

6. For what value of k , will the following pair of linear equations have no solution?

$$2x + 3y = 1 \text{ and } (3k - 1)x + (1 - 2k)y = 2k + 3.$$

☞ **Solution:** Given, $2x + 3y = 1$ (1);
 $(3k - 1)x + (1 - 2k)y = 2k + 3$... (2)

The pairs of linear equations have no solution, if

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \Rightarrow \frac{2}{3k-1} = \frac{3}{1-2k} \Rightarrow 2 - 4k = 9k - 3$$

$$\Rightarrow 13k = 5. \therefore k = 5/13.$$

7. Solve $|2x - 3| < 5$.

☞ **Solution:** $|2x - 3| < 5$
 $\Rightarrow -5 < 2x - 3 < 5 \Rightarrow -2 < 2x < 8 \Rightarrow -1 < x < 4$.
 \therefore Solution set is $\{x/-1 < x < 4\}$ or $x \in (-1, 4)$

8. Solve $|3x + 2| \geq 7$.

☞ **Solution:** $|3x + 2| \geq 7$
 $3x + 2 \geq 7$ or $3x + 2 \leq -7 \Rightarrow 3x \geq 5$ or $3x \leq -9$
 $x \geq 5/3$ or $x \leq -3$. \therefore Solution set is

$$\left\{x/x \geq \frac{5}{3} \text{ or } x \leq -3\right\} \text{ or } (-\infty, -3] \cup \left[\frac{5}{3}, \infty\right)$$

9. Solve $|5x - 7| < -18$.

☞ **Solution:** The modulus of any number has to be 0 or positive. Thus, there are no values of x which satisfy the given inequality. The solution set is ϕ .

10. If $|x + 3| > -5$, then find the solution set for the inequality.

☞ **Solution:** Given $|x + 3| > -5$
Clearly, $|x + 3|$ is a positive value for all $x \in \mathbb{R}$ which is always greater than any negative value i.e., -5 . \therefore Solution set is \mathbb{R}

11. Find the roots of the equation $x^2 + 3x - 4 = 0$.

☞ **Solution:** $x^2 + 3x - 4 = 0 \Rightarrow x^2 - x + 4x - 4 = 0$
 $\Rightarrow x(x - 1) + 4(x - 1) = 0 \Rightarrow (x + 4)(x - 1) = 0$
 $\therefore x = -4$ or $x = 1$

12. Find the roots of the equation $4x^2 - 13x + 10 = 0$.

☞ **Solution:** $4x^2 - 13x + 10 = 0$
 $\Rightarrow 4x^2 - 8x - 5x + 10 = 0$
 $\Rightarrow 4x(x - 2) - 5(x - 2) = 0 \Rightarrow (4x - 5)(x - 2) = 0$
 $\therefore x = 5/4$ or $x = 2$.

13. Solve $|x|^2 - 7|x| + 12 = 0$.

☞ **Solution:** Given equation is $|x|^2 - 7|x| + 12 = 0$
 $\Rightarrow (|x| - 3)(|x| - 4) = 0$
 $\Rightarrow |x| = 3$ or $|x| = 4 \Rightarrow x = \pm 3$ or $x = \pm 4$.

14. Solve for x : $3^{x+1} + 3^{2x+1} = 270$.

☞ **Solution:** $3^{x+1} + 3^{2x+1} = 270$
 $\Rightarrow 3 \cdot 3^x + 3 \cdot 3^{2x} = 270$
 $\Rightarrow 3^x + 3^{2x} = 90$
Substituting $3^x = a$, we get, $a + a^2 = 90$
 $\Rightarrow a^2 + a - 90 = 0 \Rightarrow a^2 + 10a - 9a - 90 = 0$
 $\Rightarrow (a + 10)(a - 9) = 0 \Rightarrow a = 9$ or $a = -10$
If $3^x = 9$, then $x = 2$. If $3^x = -10$, which is not possible. $\therefore x = 2$

15. If α and β are the roots of the equation $x^2 - 6x + 8 = 0$, then find the values of

- (i) $\alpha^2 + \beta^2$ (ii) $1/\alpha + 1/\beta$
(iii) $\alpha - \beta$ ($\alpha > \beta$)

☞ **Solution:** From the given equation, we get $\alpha + \beta = 6$ and $\alpha\beta = 8$

(i) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = (6)^2 - 2(8) = 20$

(ii) $1/\alpha + 1/\beta = \frac{\alpha + \beta}{\alpha\beta} = 6/8 = 3/4$

(iii) $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

$$\Rightarrow (\alpha - \beta) = \pm \sqrt{(\alpha + \beta)^2 - 4\alpha\beta} = \sqrt{6^2 - 4(8)}$$

$$\Rightarrow (\alpha - \beta) = \pm 2.$$

$$\therefore \alpha - \beta = 2, (\because \alpha > \beta)$$

16. For what value of x , $8x^2 - 7x + 2$ has the minimum value?

☞ **Solution:** $8x^2 - 7x + 2$ has a minimum value since $8 > 0$.

The minimum value attains at $\frac{-b}{2a}$ which is $\frac{7}{16}$

17. Find the minimum value of $x^2 + 12x$.

☞ **Solution:** Given expression is $x^2 + 12x = (x + 6)^2 - 36$
 $\Rightarrow (x + 6)^2 - 36 \geq -36$ for any real value of x
 \therefore Minimum value of $x^2 + 12x$ is -36 .

18. Discuss the nature of the roots of the equation $4x^2 - 2x + 1 = 0$.

☞ **Solution:** Discriminant $= (-2)^2 - 4(4)(1) = 4 - 16 = -12 < 0$.
Since the discriminant is negative, the roots are imaginary.

19. The denominator of a fraction exceeds the numerator by 3. The sum of the fraction and its multiplicative inverse is $29/28$. Find the fraction.

☞ **Solution:** Let the fraction be $\frac{x}{x+3}$.

Its multiplicative inverse $= \frac{x+3}{x}$.

Given, $\frac{x}{x+3} + \frac{x+3}{x} = 2\frac{9}{28}$

$$\Rightarrow x^2 + (x + 3)^2 = \frac{65}{28}x(x + 3) \Rightarrow 56x^2 + 168x +$$

$$252 = 65x^2 + 195x \Rightarrow 9x^2 + 27x - 252 = 0$$

$$\Rightarrow x^2 + 3x - 28 = 0 \Rightarrow (x + 7)(x - 4) = 0$$

$$\Rightarrow x = 4 \text{ or } -7$$

\therefore The fraction is $4/7$.

20. (a) Solve $x^2 + 6x + 13 > 0$.

☞ **Solution:**

(a) Given inequation is $x^2 + 6x + 13 > 0$. Here, factorization is not possible.

Rewriting the given inequation we get $(x^2 + 6x + 9) + 4 > 0$

$\Rightarrow (x+3)^2 + 4 > 0$. We know that $(x+3)^2 \geq 0$

$\forall x \in \mathbb{R}, (x+3)^2 + 4 \geq 4 > 0 \forall x \in \mathbb{R}$,

\therefore The required solution is the set of all real numbers, i.e., $(-\infty, \infty)$.

(b) Solve the inequation $x^2 - 2x - 63 < 0$.

👉 **Solution:**

(b) $x^2 - 2x - 63 < 0$

$$x^2 - 9x + 7x - 63 < 0$$

$$x(x-9) + 7(x-9) < 0$$

$$(x-9)(x+7) < 0$$

$$x-9 < 0 \text{ and } x+7 > 0 \Rightarrow x < 9 \text{ and } x > -7 \text{ or}$$

$$x-9 > 0 \text{ and } x+7 < 0$$

$$x > 9 \text{ and } x < -7$$

\therefore Solution set is $\{x/-7 < x < 9\}$

(c) Solve: $\frac{x^2+5x+3}{x+2} < x$.

👉 **Solution:** $\frac{x^2+5x+3}{x+2} < x$

$$\Rightarrow \frac{x^2+5x+3}{x+2} - x < 0$$

$$\Rightarrow \frac{x^2+5x+3-x^2-2x}{x+2} < 0 \Rightarrow \frac{3x+3}{x+2} < 0$$

$$\Rightarrow \frac{x+1}{x+2} < 0 \quad \dots\dots\dots (1)$$

To solve (1), it is sufficient to solve $(x+1)(x+2) < 0$.

We know that $(x-\alpha)(x-\beta) < 0$

$\Rightarrow \alpha < x < \beta$ where $(\alpha < \beta)$.

$\therefore -2 < x < -1$.

Thus, the required solution is $-2 < x < -1$

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 38: Select the correct alternative from the given choices.

1. The number of common solutions for the system of linear equations $5x + 4y + 6 = 0$ and $10x + 8y = 12$ is _____.
 (1) 0 (2) 1
 (3) infinite (4) None of these
2. If $99x + 101y = 400$ and $101x + 99y = 600$, then $x + y$ is _____.
 (1) 4 (2) 5
 (3) 8 (4) 10
3. It $\frac{x}{a} + \frac{y}{b} = a^2 + b^2$ and $\frac{x}{a^2} + \frac{y}{b^2} = a + b$, then $x =$
 (1) a (2) a^2
 (3) a^3 (4) a^4
4. The sum of the ages of X and Y, 12 years ago, was 48 years and the sum of the ages of X and Y, 12 years hence will be _____ years.
 (1) 60 (2) 72
 (3) 84 (4) 96
5. If the numerator of a fraction is increased by 2 and the denominator is decreased by 4, then it becomes 2. If the numerator is decreased by 1 and the denominator is increased by 2, then it becomes $\frac{1}{3}$. Find the sum of the numerator and denominator of the fraction.
 (1) 9 (2) 10
 (3) 11 (4) 12
6. In a fraction, if the numerator is decreased by 1 and the denominator is increased by 1, then the resulting fraction is $\frac{1}{4}$. Instead, if the numerator is increased by 1 and the denominator is decreased by 1, then the resulting fraction is $\frac{2}{3}$. Find the difference of the numerator and the denominator of the fraction.
 (1) 4 (2) 5
 (3) 6 (4) None of these
7. A and B, have some coins. If A gives 100 coins to B, then B will have twice the number of coins left with A. Instead, if B gives 40 coins to A, then A will have thrice the number of coins left with B. How many more coins does A have than B?
 (1) 212 (2) 186
 (3) 124 (4) 88
8. The ratio of monthly incomes of Mr X and Mr Y is 3: 4 and the ratio of their monthly expenditures is 5: 7. If the ratio of their monthly savings is 3: 2 and Mr X saves ₹500 more than Mr Y per month, then find the monthly income of Mr Y [in ₹]
 (1) 22000 (2) 16500
 (3) 11000 (4) 5500
9. Sanjana travels 660 km, partly by train and partly by car. If she covers 300 km by train and the rest by car, it takes 13.5 hours. But, if she travels 360 km by train and the rest by car, she takes 30 minutes longer. Find the time taken by Sanjana if she travels 660 km by car (in hrs).
 (1) 9 (2) 10
 (3) 11 (4) None of these
10. Total cost of 15 erasers and 25 pencils is ₹185 and the total cost of 9 erasers and x pencils is ₹106. Which of the following cannot be the value of x ?
 (1) 12 (2) 10
 (3) 13 (4) 15
11. Solve for x : $|x + 4| < 12$
 (1) $[-16, 8]$ (2) $(-16, 8]$
 (3) $[-16, 8)$ (4) $(-16, 8)$
12. If $|x + 7| > -8$, then find the solution set.
 (1) Q (2) N
 (3) W (4) R
13. If $|9 - x| < 2 - 3x$. Find the range of $x \in \mathbb{R}$.
 (1) $(-\infty, 0)$ (2) $(-\infty, \frac{-7}{2})$
 (3) $(-\infty, -3)$ (4) $(-16, 8)$
14. Bhanu has a total of 40 coins of denominations 30 paise and 10 paise. The total amount with him is ₹9. Find the number of 10 paise coins with him.
 (1) 25 (2) 35
 (3) 15 (4) 20
15. The line $y = 5x - 6$ meets the parabola $y = x^2$ in two points where x -coordinates are _____ and _____.

- (1) 2 or 3 (2) -2 or -3
(3) 1 or 6 (4) -1 or -6
16. If the equations $x^2 + 3x + 2 = 0$ and $x^2 + kx + 6 = 0$ have a common root, then find the values of k.
(1) -1, -2 (2) 5, 7
(3) 7, -2 (4) -1, 5
17. Find the sum of the roots of $\frac{1}{x} - \frac{1}{x-a} = \frac{1}{b} - \frac{1}{b-a}$, ($a \neq 0$).
(1) a (2) b
(3) a - b (4) a + b
18. If $(x+2)(x+4)(x+6)(x+8) = 945$ and x is an integer, then find x.
(1) -1 (2) 1
(3) -11 (4) (2) or (3)
19. Find the roots of $|y|^2 - |y| - 12 = 0$.
(1) -3, 3 (2) -4, 4
(3) -3, -4 (4) 3, 4
20. The roots of $ax^2 + bx + c = 0$ are α and β . Find the quadratic equation in x whose roots are $\alpha\beta^2$ and $\beta\alpha^2$.
(1) $a^3x^3 - abcx + c^3 = 0$
(2) $a^3x^3 - abcx - c^3 = 0$
(3) $a^3x^2 + abcx - c^3 = 0$
(4) $a^3x^2 + abcx + c^3 = 0$
21. If $\alpha + \beta$ are the roots of $x^2 + 3x + 3 = 0$, then find the quadratic equation whose roots are $(\alpha + \beta)$ and $\alpha\beta$.
(1) $x^2 = 1$ (2) $x^2 = 4$
(3) $x^2 = 9$ (4) None of these
22. If the roots of the equation $px^2 + qx + r = 0$, is 3: 4, then $12q^2 =$ _____.
(1) 49 pr (2) 36 pr
(3) 64 pr (4) 81 pr
23. Umesh and Varun are solving an equation of the form $x^2 + bx + c = 0$. In doing so, Umesh commits a mistake in noting down the constant term and finds the roots as -3 and -12. And Varun commits a mistake in noting down the coefficient of x and finds the roots as -27 and -2. If so, find the original equation.
(1) $x^2 - 15x + 36 = 0$
(2) $x^2 + 15x + 36 = 0$
(3) $x^2 - 15x + 54 = 0$
(4) $x^2 + 15x + 54 = 0$
24. Find the nature of the roots of $2x^2 - 8x + 7 = 0$.
(1) Rational and equal
(2) Rational and distinct
(3) Irrational and distinct
(4) Imaginary
25. The roots of $(p^2 + q^2)x^2 + 2(q^2 + r^2)x + (q^2 + r^2) = 0$ are equal. Which of the following must be true?
(1) $q = r = 0$
(2) $r = p$
(3) $r = -p$
(4) At least one of (1), (2) and (3)
26. Match the column A with column B.
- | Column A | Column B |
|---|--------------------------------------|
| (a) $\Delta = 0$ | () (p) roots are rational |
| (b) $\Delta < 0$ | () (q) roots are real and equal |
| (c) $\Delta > 0$ and perfect square | () (r) roots are irrational |
| (d) $\Delta > 0$ and not perfect square | () (s) roots are complex conjugates |
- (1) $a \rightarrow q$; $b \rightarrow s$; $c \rightarrow r$; $d \rightarrow p$
(2) $a \rightarrow s$; $b \rightarrow q$; $c \rightarrow p$; $d \rightarrow r$
(3) $a \rightarrow q$; $b \rightarrow s$; $c \rightarrow p$; $d \rightarrow r$
(4) None of these
27. If the quadratic equation $x^2 - mx - 4x + 1 = 0$ has real and distinct roots, then find the value of m.
A. $(-\infty, -6)$
B. $(-\infty, -3)$ C. $(-2, \infty)$ D. $(2, \infty)$
(1) A or C (2) A or D
(3) B or C (4) B or D
28. The equation $9y^2(m+3) + 6(m-3)y + (m+3) = 0$, where m is real, has real roots then
(1) $m < 0$ (2) $m > 0$
(3) $m \leq 0$ (4) $m \geq 0$
29. If a number which is less than its square by 42, then sum of the possible values of the numbers is
(1) 1 (2) 2
(3) 3 (4) 4
30. Find the perimeter of a rectangular hall, if its length exceeds its breadth by 7 m and the area of the hall being 228 m².
(1) 72 m (2) 70 m
(3) 64 (4) 62 m
31. The students of a class contributed for a programme. Each student contributed the same amount. Had there been 15 more students in the class and each

student had contributed ₹40 less, the total amount contributed would have increased from ₹3000 to ₹3200. Find the strength of the class.

- (1) 20 (2) 25
(3) 30 (4) 35

32. For which of the following intervals for y is $y^2 < \frac{1}{y^2}$?

- (1) $(-\infty, -1) \cup (1, \infty)$ (2) $(-\infty, -1] \cup [1, \infty)$
(3) $(-1, 1)$ (4) $(-1, 0) \cup (0, 1)$

33. P and Q are two consecutive even numbers with $P < Q$ and $PQ < 48$. Find the range of possible values of P.

- (1) $\{-6, -4, -2, 0, 2, 4, 6\}$ (2) $\{-6, -4, -2, 2, 4, 6\}$
(3) $\{-6, -4, -2, 0, 2, 4\}$ (4) $\{-4, -2, 0, 2, 4, 6\}$

34. Find the maximum value of y which satisfy the inequations $y^2 + 5y + 4 \leq 0$ and $y^2 - 2y - 15 \geq 0$.

- (1) -4 (2) -3
(3) 3 (4) 4

35. If $\frac{y^2 + y - 6}{y^2 + y - 2} < 0$, then find the least integer value of y ?

- (1) -3 (2) -2
(3) 2 (4) Does not exist

36. The product of two consecutive even numbers exceeds twice their sum by more than 20. Find the range of values that the smaller (x) of the numbers can take.

- (1) $x > 6$ (2) $x < -4$
(3) $x > 0$ (4) Both (1) and (2)

37. In a class the ratio of the number of boys to that of the girls is 7: 3. Each boy is given only a 50 paise coin and each girl is given a 75 paise coin (assuming 75 paise coins are available). The difference in the amount present with the boys and the girls is ₹3.75. How many coins should the boys and girls exchange

so that the amount with the boys becomes twice the amount with the girls?

- (1) 8 (2) 6
(3) 4 (4) 9

38. A person on an exercise regime decides to lose 500 calories in a day. For every 30 minutes of exercise he loses 80 calories, but gains 25 calories per cake that he eats. In the morning he exercises for a certain time and he eats a certain number of cakes. In the afternoon he exercises for double the time but eats thrice the number of cakes. In the evening he exercises for 1.5 times the time he spends in the morning session and eats 4 times the number of cakes he eats in the morning. Had he not eaten any cake, he would have exceeded his target by 220 calories. If he actually falls short of his target by 180 calories, then, what is the number of cakes he has eaten in the evening?

- (1) 12 (2) 8
(3) 16 (4) 10

Directions for questions 39 and 40: Answer these questions based on the information below.

A shopkeeper sold a certain number of toys. The number of toys as well as the price of each toy (in ₹) was a two digit number. By mistake, he reversed the digits of both the number of toys he sold and the price of each toy. As a result, he found that his stock account at the end of the day showed 81 items more than it actually was.

39. Find the actual number of toys sold.

- (1) 92 (2) 81
(3) 90 (4) 29

40. If the faulty calculations show a total sale of ₹882, find the actual selling price of each toy (in ₹).

- (1) 89 (2) 98
(3) 97 (4) 79

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 43: Select the correct alternative from the given choices.

1. If $\frac{1}{x} + \frac{1}{y} = k$ and $\frac{1}{x} - \frac{1}{y} = k$, then the value of y

- (1) -1
(2) 0

- (3) 1
(4) Does not exist

2. The number of common solutions of $x + 2y = 8$ and $2x + y = 8$ is ____.

- (1) 0 (2) 1
(3) 2 (4) infinite

3. If $331a + 247b = 746$ and $247a + 331b = 410$, then find a.
- (1) -1 (2) 2
(3) 3 (4) 6
4. For what value of k will the equations $3x - 4y = 5$ and $9x - 12y = k$ be consistent?
- (1) 10 (2) 12
(3) 15 (4) 18
5. The sum of the heights of A and B is 320 cm and the difference of heights of A and B is 20 cm. The height of B can be ____.
- (1) 140 cm (2) 145 cm
(3) 150 cm (4) 155 cm
6. Five years hence, the age of father will be thrice the age of his son. Two years ago, father's age was four times his son's age. Find the sum of their present ages (in years).
- (1) 74 (2) 58
(3) 50 (4) 48
7. Jaydeep starts his job with a certain monthly salary and earns a fixed increment in his monthly salary at the middle of every year, starting from the first year. If his monthly salary was ₹78000 at the end of 6 years of service and ₹84000 at the end of 12 years of service, find his initial salary and annual increment (in ₹).
- (1) 64000 (2) 72000
(3) 84000 (4) 92000
8. A two-digit number is such that, it exceeds the sum of the number formed by reversing the digits and sum of the digits by 4. Also, the original number exceeds the reversed number by 18. Find the product of the digits.
- (1) 24 (2) 30
(3) 36 (4) 48
9. Snehal can row 28 km downstream and 12 km upstream in 5 hours. He can row 21 km downstream and 10 km upstream in 4 hours. Find the speed of Snehal in still water (in kmph).
- (1) 6 (2) 9
(3) 12 (4) 15
10. A two-digit number is seven times the sum of its digits. The number formed by reversing the digits is 6 more than half of the original number. Find the difference of the digits of the given number.
- (1) 8 (2) 6
(3) 4 (4) 2
11. The average weight of the students of a class is 60 kg. If eight new students of average weight 64 kg join the class, the average weight of the entire class becomes 62 kg. How many students were there in the class initially?
- (1) 8 (2) 12
(3) 16 (4) 24
12. Solve for x : $|x - 3| > 4$.
- (1) $x < -1$ (2) $x > 7$
(3) $x < 2$ (4) (1) or (2)
13. What are the real values of x that satisfy the inequalities $6x + 9 < 3x + 5$ and $4x + 7 > 2x - 5$?
- (1) $\left(-6, \frac{-4}{3}\right)$ (2) $\left(\frac{-2}{3}, 5\right)$
(3) $\left(\frac{7}{3}, 10\right)$ (4) $\left(-5, \frac{2}{3}\right)$
14. The cost of two pens, three pencils and four erasers is ₹46 and the cost of three pens, one pencil and six erasers is ₹62. Find the cost of each pencil.
- (1) ₹2 (2) ₹3
(3) ₹2.5 (4) ₹3.5
15. If $4x^4 - 20x^2 + 9 = 0$, then $x =$ ____.
- (1) $\pm \frac{1}{\sqrt{2}}, \pm \frac{\sqrt{3}}{2}$ (2) $\pm \frac{1}{\sqrt{2}}, \pm \sqrt{\frac{3}{2}}$
(3) $\pm \frac{1}{\sqrt{2}}, \pm \frac{3}{2}$ (4) $\pm \frac{1}{\sqrt{2}}, \pm \frac{3}{\sqrt{2}}$
16. If $x^4 - 17x^2 + 16 = 0$, then find the sum of the squares of the roots.
- (1) 9 (2) 16
(3) 34 (4) 289
17. It $\sqrt{y+1} - \sqrt{y-1} = \sqrt{4y-1}$, then $y =$
- (1) 5/4 (2) 3/2
(3) 1/2 (4) No solution
18. If $3(3^{2y+1}) - 13(3^{y+1}) + 12 = 0$, then find the value of y (which is rational).
- (1) -1 (2) 0
(3) 1 (4) 2
19. The roots of $x^2 - 10x + 21 = 0$ are p and q . Find $p^3 + q^3$.
- (1) 539 (2) 152
(3) 243 (4) 370

20. If α and β are the roots of $x^2 + x + 1 = 0$, then find the equation whose roots α^2 and β^2 .
- (1) $x^2 + x + 1 = 0$ (2) $x^2 + 2x + 1 = 0$
 (3) $x^2 + x + 2 = 0$ (4) $x^2 + 2x + 2 = 0$
21. The difference of the roots of $2y^2 - ky + 16 = 0$ is $1/3$. Find k .
- (1) $\pm \frac{30}{3}$ (2) $\pm \frac{32}{3}$
 (3) $\pm \frac{34}{3}$ (4) $\pm \frac{38}{3}$
22. Rohan and Sohan were attempting to solve the quadratic equation, $x^2 - ax + b = 0$. Rohan copied the coefficient of x wrongly and obtained the roots as 4 and 12. Sohan copied the constant term wrongly and obtained the roots as -19 and 3. Find the correct roots.
- (1) $-8, -10$ (2) $-8, -6$
 (3) $-4, -12$ (4) $4, 12$
23. Find the maximum/minimum value of the quadratic expression $-x^2 + 8x + 1$.
- (1) Minimum value is 17
 (2) Minimum value is -34
 (3) Maximum value is 17
 (4) Maximum value is 34
24. In the previous question, find the value of x for which the maximum/minimum value occurs.
- (1) 2 (2) 4
 (3) -4 (4) -2
25. If one of the roots of $ax^2 + bx + c = 0$ is $7 + \sqrt{2}$, then find the other root.
- (1) $-7 + \sqrt{2}$ (2) $7 - \sqrt{2}$
 (3) $-7 - \sqrt{2}$ (4) Cannot be determined
26. The equation $(m+1)x^2 + 2mx + 5x + m + 3 = 0$ has equal roots. Find the value of m .
- (1) $-11/4$ (2) $-13/4$
 (3) $-15/4$ (4) $-17/4$
27. The roots of the equation $x^2 - px + q = 0$ are consecutive integers. Find the discriminant of the equation.
- (1) -1 (2) 0
 (3) 1 (4) None of these
28. If the sides of a right angled triangle are x , $3x + 3$, and $3x + 4$, then find x .
- (1) -1 (2) 7
 (3) 6 (4) Both (1) and (2)
29. A number consists of two digits whose product is 18. If 27 is added to the number, the number formed will have the digits in reverse order, when compared to the original number. Find the sum of the digit of the number.
- (1) 9 (2) 11
 (3) 15 (4) 18
30. The solution set of $x^2 - x - 6 < 0$ is ____.
- (1) R (2) $(-2, 3)$
 (3) $[-2, 3]$ (4) $(-\infty, -2) \cup (3, \infty)$
31. The solution set of $x^2 - 8x + 15 \geq 0$ is ____.
- (1) R (2) $(-\infty, -1]$
 (3) $[3, 5]$ (4) $(-\infty, -3] \cup [5, \infty)$
32. If $y^2 < x$ and $x \in (-\infty, 0)$, then y must
- (1) be positive (2) be negative
 (3) have no real value (4) None of the above
33. Solution of the inequation $x^2 + 20x + 96 > 0$.
- A. $x < -12$ B. $x < -16$
 C. $x > -10$ D. $x > -8$
 (1) A or C (2) A or D
 (3) B or C (4) B or D
34. Determine the values of x which satisfy the inequations $x^2 + 5x + 4 > 0$ and $-x^2 - x + 42 > 0$.
- (1) $(-7, -4)$ (2) $(-1, 6)$
 (3) $(2, 3)$ (4) (1) or (2)
35. If $-(4x + 27) < (x + 6)^2 < -4(6 + x)$, then find the number of integer values of x .
- (1) 0 (2) 1
 (3) 2 (4) None of these
36. If $|y|^2 - 4|y| - 60 \leq 0$, then find the range of y ?
- (1) $[-10, 10]$ (2) $[-12, 12]$
 (3) $[-15, 15]$ (4) $[-20, 20]$
37. Solve for x : $x^2 + 2|x| - 35 > 0$.
- (1) $(-\infty, 1)$ (2) $(-\infty, -5)$
 (3) $(5, \infty)$ (4) (2) or (3)
38. If the roots of the equation $3x^2 + 9x + 2 = 0$ are in the ratio $m:n$, then find $\sqrt{\frac{m}{n}} + \sqrt{\frac{n}{m}}$.
- (1) $\frac{3\sqrt{3}}{\sqrt{2}}$ (2) $3\sqrt{2}$
 (3) $\frac{\sqrt{2}}{\sqrt{3}}$ (4) $2\sqrt{3}$

39. Ashok went to a casino to play a card game. In each round he happened to double the amount with himself and in each round he gave ₹ x to his friend. At the end of three rounds, he was left with no money. If the amount he gave to his friend in each round was ₹20 more than the amount he started with, find the amount (in ₹) that he started with.
- (1) 110 (2) 120
(3) 130 (4) 140
40. Ten children are standing in a line. Each child has some chocolates with him. If the first child attempted to double the number of chocolates with each of the others he would fall short by two chocolates. If the second child took two chocolates from each of the remaining, he would have three chocolates less than what the first child initially had. Find the total number of chocolates with the third to the tenth child.
- (1) 18 (2) 19
(3) 23 (4) 21
41. Five three-digit numbers including N , were to be added. While adding, the reverse of N was added by mistake instead of N . Hence, the sum increased by 11 times the sum of the digits of N . Eight times the difference of N 's units and hundreds digits is 6 more than twice its hundreds digit. Find its tens digit.
- (1) 4 (2) 6
(3) 8 (4) 2
42. Amar, Bhavan, Chetan and Dinesh each had some money. Dinesh doubled the amounts with the

others. Chetan then doubled the amounts with the others. Bhavan then doubled the amounts with the others. Amar then doubled the amounts with the others. At this stage, each of them has ₹80. Find the initial amount with Chetan (in ₹).

- (1) 45 (2) 65
(3) 95 (4) 85

43. The square of the sum of the digits of a two-digit number is equal to 40 more than the sum of the squares of its digits. Find the number.

- (1) 18
(2) 27
(3) 36
(4) Cannot be determined

Directions for questions 44 and 45: Answer these questions based on the information below.

Rakesh went to a stationery shop to purchase a total of 38 pens, erasers and sharpeners. He purchased at least 11 items of each. He purchased more sharpeners than erasers and more erasers than pens.

44. How many pens did he purchase?

- (1) 11 (2) 12
(3) 13 (4) 14

45. If each pen cost ₹2, each eraser cost ₹3 and each sharpener cost ₹4, find the minimum expenditure he could have incurred on the items (in ₹).

- (1) 116 (2) 118
(3) 117 (4) 119

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 4 | 5. 3 | 6. 1 | 7. 4 | 8. 1 | 9. 3 | 10. 4 |
| 11. 4 | 12. 4 | 13. 2 | 14. 3 | 15. 1 | 16. 2 | 17. 1 | 18. 4 | 19. 2 | 20. 4 |
| 21. 3 | 22. 1 | 23. 4 | 24. 3 | 25. 4 | 26. 3 | 27. 1 | 28. 3 | 29. 1 | 30. 4 |
| 31. 2 | 32. 4 | 33. 3 | 34. 2 | 35. 4 | 36. 4 | 37. 3 | 38. 2 | 39. 3 | 40. 1 |

PRACTICE EXERCISE 2 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 3 | 4. 3 | 5. 3 | 6. 1 | 7. 2 | 8. 4 | 9. 2 | 10. 3 |
| 11. 1 | 12. 4 | 13. 1 | 14. 1 | 15. 4 | 16. 3 | 17. 4 | 18. 1 | 19. 4 | 20. 1 |
| 21. 3 | 22. 3 | 23. 3 | 24. 2 | 25. 2 | 26. 2 | 27. 3 | 28. 2 | 29. 1 | 30. 2 |
| 31. 4 | 32. 3 | 33. 2 | 34. 4 | 35. 1 | 36. 1 | 37. 4 | 38. 1 | 39. 4 | 40. 3 |
| 41. 2 | 42. 4 | 43. 4 | 44. 1 | 45. 3 | | | | | |

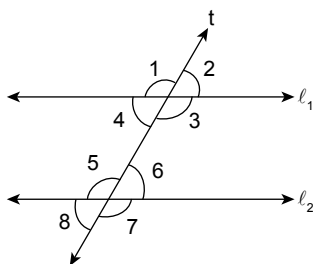
Geometry

SYNOPSIS

- **Parallel lines:** Two co-planar lines that do not have a common point are called parallel lines.
In the figure given above, ℓ_1 and ℓ_2 are parallel lines. We write $\ell_1 \parallel \ell_2$ and read as ℓ_1 is parallel to ℓ_2 .

Properties of Parallel Lines

- (1) The perpendicular distance between two parallel lines is equal everywhere.
 - (2) Two lines lying in the same plane and perpendicular to the same line are parallel to each other.
 - (3) If two lines are parallel to the same line, then they are parallel to each other.
 - (4) One and only one parallel line can be drawn to a given line through a given point which is not on the given line.
- **Transversal:** A straight line intersecting a pair of straight lines in two distinct points is a transversal for the two given lines.



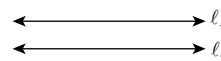
Let ℓ_1 and ℓ_2 be a pair of lines and t be a transversal.

As shown in the figure, totally eight angles are formed.

If ℓ_1 and ℓ_2 are parallel, then the

- (i) corresponding angles are equal, i.e., $\angle 1 = \angle 5$, $\angle 2 = \angle 6$, $\angle 3 = \angle 7$ and $\angle 4 = \angle 8$.
- (ii) alternate interior angles are equal, i.e., $\angle 4 = \angle 6$ and $\angle 3 = \angle 5$.
- (iii) alternate exterior angles are equal, i.e., $\angle 1 = \angle 7$ and $\angle 2 = \angle 8$.
- (iv) exterior angles on the same side of the transversal are supplementary, i.e., $\angle 1 + \angle 8 = 180^\circ$ and $\angle 2 + \angle 7 = 180^\circ$.
- (v) interior angles on the same side of the transversal are supplementary, i.e., $\angle 4 + \angle 5 = 180^\circ$ and $\angle 3 + \angle 6 = 180^\circ$.

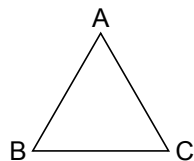
- **Intercepts:** If a transversal t intersects two lines ℓ_1 and ℓ_2 in distinct points P and Q, then the lines ℓ_1 and ℓ_2 are said to make an intercept PQ on t .



In the figure given above, \overline{PQ} is an intercept on t .

A pair of parallel lines makes equal intercepts on all transversals which are perpendicular to them.

- **Triangles:** A triangle is a three sided simple closed plane figure.



Types of triangles: A. Based on sides:

- (i) Scalene triangle: A triangle in which no two sides are equal.
- (ii) Isosceles triangle: A triangle in which a minimum of two sides are equal.
- (iii) Equilateral triangle: A triangle in which all the three sides are equal.

B. Based on angles:

- (i) Acute-angled triangle: A triangle in which each angle is less than 90° .
- (ii) Right-angled triangle: A triangle in which one of the angles is equal to 90° .
- (iii) Obtuse-angled triangle: A triangle in which one of the angles is greater than 90° .

A triangle in which two sides are equal and one angle is 90° , is an isosceles right triangle. The hypotenuse is $\sqrt{2}$ times each equal side.

Important Properties of Triangles

1. The sum of the angles of a triangle is 180° .
2. The measure of an exterior angle is equal to the sum of the measures of its interior opposite angles.
3. If two sides of a triangle are equal, then the angles opposite to them are also equal.
4. If two angles of a triangle are equal, then the sides opposite to them are also equal.
5. Each angle in an equilateral triangle is equal to 60° .
6. In a right-angled triangle the square of the hypotenuse is equal to the sum of the squares of the other two sides.
7. The sum of any two sides of a triangle is always greater than the third side.

In a $\triangle ABC$,

- (i) $AB + BC > AC$,
- (ii) $BC + AC > AB$ and
- (iii) $AB + AC > BC$.

8. The difference of any two sides of a triangle is less than the third side.

In a $\triangle ABC$,

- (i) $(BC - AB) < AC$,
- (ii) $(AC - BC) < AB$ and
- (iii) $(AC - AB) < BC$.

9. In a triangle ABC , if $\angle B > \angle C$, then the side opposite to $\angle B$ is longer than the side opposite to $\angle C$, i.e., $AC > AB$.

10. In triangle ABC given above, if $AC > BC$, then the angle opposite to side AC is greater than the angle opposite to side BC , i.e., $\angle B > \angle A$.

- **Congruence of triangles:** Two geometrical figures are congruent if they have the same shape and the same size.

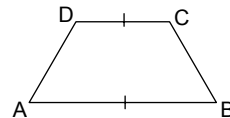
The three angles of a triangle determine its shape and its three sides determine its size. If the three angles and the three sides of a triangle are respectively equal to the corresponding angles and sides of another triangle, then the two triangles are congruent. However, it is not necessary that each of the six elements of one triangle is equal to the corresponding elements of the other triangle in order to conclude that the two triangles are congruent.

Based on the study and experiments, the following results can be used to establish the congruence of two triangles.

Different Types of Quadrilaterals

1. **Trapezium:** In a quadrilateral, if two opposite sides are parallel to each other, then it is called a trapezium.

In the given figure $\overline{AB} \parallel \overline{CD}$, hence $ABCD$ is a trapezium.



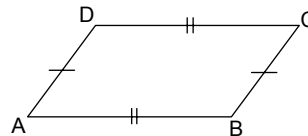
2. **Parallelogram:** In a quadrilateral, if both the pairs of opposite sides are parallel, then it is called a parallelogram.

In the given figure,

- (i) $AB = CD$ and $BC = AD$.
- (ii) $\overline{AB} \parallel \overline{CD}$ and $\overline{BC} \parallel \overline{AD}$.

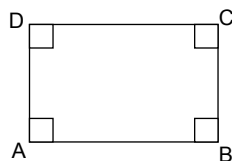
Hence, $ABCD$ is a parallelogram.

Note: In a parallelogram, diagonals need not be equal, but they bisect each other.



3. **Rectangle:** In a parallelogram, if each angle is a right angle (90°), then it is called a rectangle.

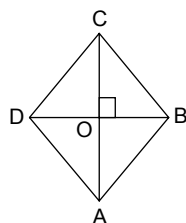
In the given figure, $\angle A = \angle B = \angle C = \angle D = 90^\circ$, $AB = CD$ and $BC = AD$.



Hence, ABCD is a rectangle.

Note: In a rectangle, the diagonals are equal, i.e., $AC = BD$.

4. **Rhombus:** In a parallelogram, if all the sides are equal, then it is called a rhombus. In the given figure, $AB = BC = CD = AD$, hence ABCD is a rhombus.



Note:

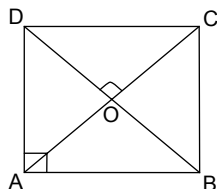
- (1) In a rhombus, the diagonals need not be equal.
- (2) In a rhombus, the diagonals bisect each other at right angles, i.e., $AO = OC$, $BO = OD$ and $AC \perp DB$.

5. **Square:** In a rhombus, if each angle is a right angle, then it is called a square.

(OR)

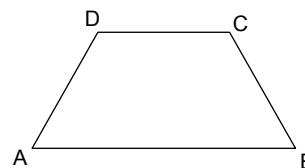
In a rectangle, if all the sides are equal, then it is called a square. In the given figure, $AB = BC = CD = DA$ and $\angle A = \angle B = \angle C = \angle D = 90^\circ$.

Hence, ABCD is a square.



Note:

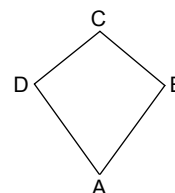
- (1) In a square, the diagonals bisect each other at right angles.
 - (2) In a square, the diagonals are equal.
6. **Isosceles trapezium:** In a trapezium, if the non-parallel opposite sides are equal, then it is called an isosceles trapezium.



In the figure, $\overline{AB} \parallel \overline{CD}$ and $BC = AD$.

Hence, ABCD is an isosceles trapezium.

7. **Kite:** In a quadrilateral, if two pairs of adjacent sides are equal, then it is called a kite.

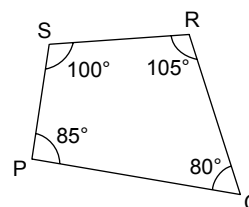


In the figure ABCD,

$AB = AD$ and $BC = CD$

Hence, ABCD is a kite.

8. **Cyclic Quadrilateral:** A quadrilateral which can be inscribed in a circle is called a cyclic quadrilateral. The opposite angles of a cyclic quadrilateral are supplementary.



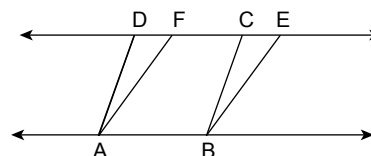
(We shall study more about such quadrilaterals in the next chapter circles)

Geometrical Results on Areas

1. Parallelograms on the same base and between the same parallels are equal in area.

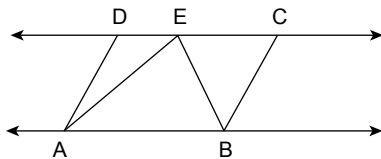
In the figure given above, parallelogram ABCD and parallelogram ABEF are on the same base \overline{AB} and between the same parallels \overline{AB} and \overline{CD} .

\therefore Area of parallelogram ABCD = Area of parallelogram ABEF.



Note: A parallelogram and a rectangle on the same base and between the same parallels are equal in area.

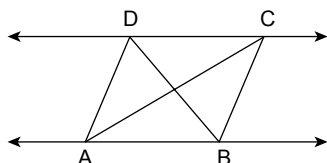
2. The area of a triangle is half the area of the parallelogram, if they lie on the same base and between the same parallels.



In the figure given above, parallelogram ABCD and $\triangle ABE$ are on the same base \overline{AB} and between the same parallels \overline{AB} and \overline{CD} .

\therefore Area of $\triangle ABE = \frac{1}{2}$ Area of parallelogram ABCD.

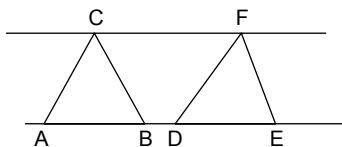
3. Triangles on the same base and between the same parallels are equal in area.



In the figure given above, $\triangle ABC$ and $\triangle ABD$ are on the same base \overline{AB} and between the same parallels \overline{AB} and \overline{CD} .

\therefore Area of $\triangle ABC =$ Area of $\triangle ABD$.

Note: Triangles with equal bases and between the same parallels are equal in area.

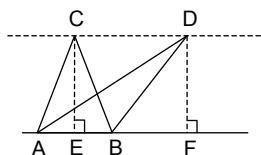


In the above given figure, in $\triangle ABC$ and $\triangle DEF$, $AB = DE$ and $\overline{AE} \parallel \overline{CF}$.

\therefore Area of $\triangle ABC =$ Area of $\triangle DEF$.

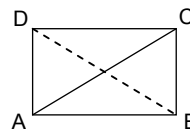
4. Triangles with equal bases and with equal areas lie between the same parallels.

In the above figure, if Area of $\triangle ABC =$ Area of $\triangle ABD$, then $\overline{AB} \parallel \overline{CD}$.



Note: In this case, altitudes CE and DF are equal.

5. A diagonal of a parallelogram divides the parallelogram into two triangles of equal area.



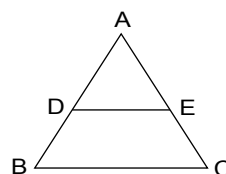
In the figure given, diagonal \overline{AC} divides parallelogram ABCD into two triangles; $\triangle ABC$ and $\triangle ACD$. Here, area of $\triangle ABC =$ area of $\triangle ACD$.

Similarly, diagonal BD divides the parallelogram into two triangles, $\triangle ABD$ and $\triangle BDC$.

Hence, the area of $\triangle ABD =$ area of $\triangle BCD$.

- Mid-point Theorem: In a triangle, the line segment joining the mid-points of any two sides is parallel to the third side and also half of it.
- Basic proportionality theorem: In a triangle, if a line is drawn parallel to one side of the triangle, then it divides the other two sides in the same ratio.
- Converse of basic proportionality theorem: If a line divides two sides of a triangle in the same ratio then that line is parallel to the third side.

In the figure given, $AD/DB = AE/EC \Rightarrow \overline{DE} \parallel \overline{BC}$.



Note: The intercepts made by three or more parallel lines on any two transversals are proportional.

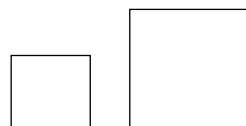
Similarity: Two figures are said to be congruent, if they have the same shape and same size. But the figures of the same shape need not have the same size. The figures of the same shape but not necessarily of the same size are called similar figures.

Examples:

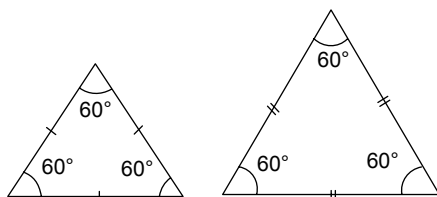
1. Any two line segments are similar.



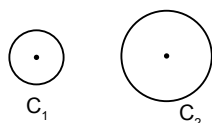
2. Any two squares are similar.



3. Any two equilateral triangles are similar.



4. Any two circles are similar.



Two polygons are said to be similar to each other if

- their corresponding angles are equal and
- the lengths of their corresponding sides are proportional.

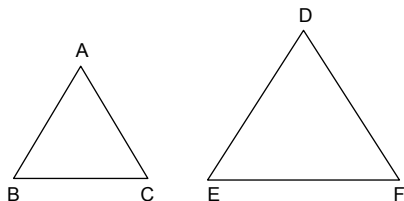
Note: “~” is the symbol used for “is similar to”.

If $\triangle ABC$ is similar to $\triangle PQR$, we denote it as $\triangle ABC \sim \triangle PQR$. The relation ‘is similar to’ satisfies the following properties.

- It is reflexive as every figure is similar to itself.
 - It is symmetric as, if A is similar to B, then B is also similar to A.
 - It is transitive as, if A is similar to B and B is similar to C, then A is similar to C.
- \therefore The relation ‘is similar to’ is an equivalence relation.

- **Criteria for similarity of triangles:** In two triangles, if either the corresponding angles are equal or the ratio of corresponding sides are proportional, then the two triangles are similar to each other.

In $\triangle ABC$ and $\triangle DEF$,



- If $\angle A = \angle D$, $\angle B = \angle E$ and $\angle C = \angle F$, then $\triangle ABC \sim \triangle DEF$. This property is called **A.A.A. criterion**.
- If $AB/DE = BC/EF = AC/DF$, then $\triangle ABC \sim \triangle DEF$. This property is called **S.S.S. criterion**.

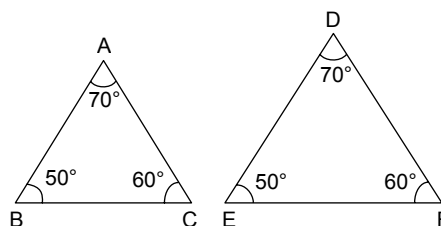
- If $AB/DE = AC/DF$ and $\angle A = \angle D$, then $\triangle ABC \sim \triangle DEF$. This property is called **S.A.S. criterion**.

Results on Areas of Similar Triangles

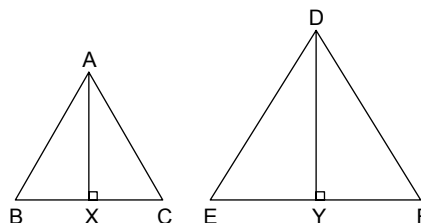
- (a) The ratio of the areas of two similar triangles is equal to the ratio of the squares of any two corresponding sides of the triangles.

$\triangle ABC \sim \triangle DEF$

$$\Rightarrow \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF} = \frac{AB^2}{DE^2} = \frac{BC^2}{EF^2} = \frac{CA^2}{FD^2}.$$



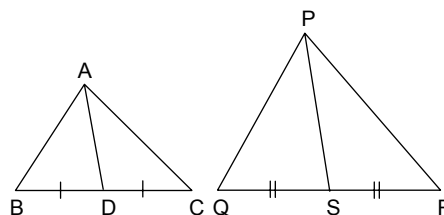
- (b) The ratio of the areas of two similar triangles is equal to the ratio of the squares of their corresponding altitudes.



In the following figures, $\triangle ABC \sim \triangle DEF$ and AX, DY are the altitudes.

$$\text{Then, } \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF} = \frac{AX^2}{DY^2}$$

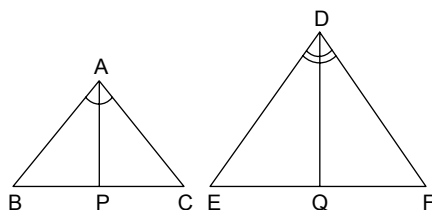
- (c) The ratio of the areas of two similar triangles is equal to the ratio of the squares on their corresponding medians.



In the above given figures, $\triangle ABC \sim \triangle PQR$ and AD and PS are medians.

$$\text{Then, } \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle PQR} = \frac{AD^2}{PS^2}$$

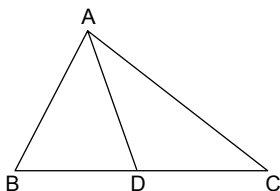
- (d) The ratio of the areas of two similar triangles is equal to the ratio of the squares of their corresponding angle bisector segments.



In the figure, $\Delta ABC \sim \Delta DEF$ and AP, DQ are bisectors of $\angle A$ and $\angle D$ respectively, then

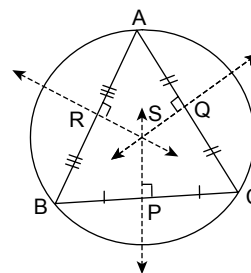
$$\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta DEF} = \frac{AP^2}{DQ^2}$$

- **Pythagorean theorem:** In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.
- **Converse of Pythagorean Theorem:** In a triangle, if the square of one side is equal to the sum of the squares of the other two sides, then the angle opposite to the first side is a right angle.
- **Polygons:** A closed plane figure bounded by three or more line segments is called a polygon.
- **Convex polygon and Concave polygon:** A polygon in which each interior angle is less than 180° is called a convex polygon. Otherwise it is called concave polygon.
- **Vertical angle bisector theorem:** The bisector of the vertical angle of a triangle divides the base in the ratio of the other two sides.
- **Converse of vertical angle bisector theorem:** If a line that passes through a vertex of a triangle, divides the base in the ratio of the other two sides, then it bisects the angle. In the adjacent figure, AD divides BC in the ratio $\frac{BD}{DC}$ and if $\frac{BD}{DC} = \frac{AB}{AC}$, then AD is the bisector of $\angle A$.

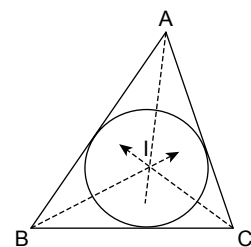


Concurrence – Geometric Centres of a Triangle

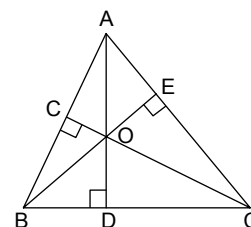
1. **Circumcentre:** The locus of the point equidistant from the end points of the line segment is the perpendicular bisector of the line segment. The three perpendicular bisectors of the three sides of a triangle are concurrent and the point of their concurrence is called the circumcentre of the triangle and is usually denoted by S . The circumcentre is equidistant from all the vertices of the triangle. The circumcentre of the triangle is the locus of the point in the plane of the triangle, equidistant from the vertices of the triangle.



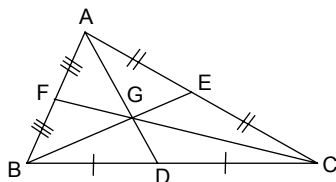
2. **Incentre:** The angle bisectors of the triangle are concurrent and the point of concurrence is called the incentre and is usually denoted by I . I is equidistant from the sides of the triangle. The incentre of the triangle is the locus of the point, in the plane of the triangle, equidistant from the sides of the triangle.



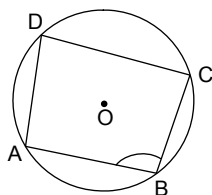
3. **Orthocentre:** The altitudes of the triangle are concurrent and the point of concurrence of the altitudes of a triangle is called orthocentre and is usually denoted by O .



4. **Centroid:** The medians of a triangle are concurrent and the point of concurrence of the medians of a triangle is called the centroid and it is usually denoted by G. The centroid divides each of the medians in the ratio 2: 1, starting from vertex, i.e., in the figure given below, $AG:GD = BG:GE = CG:GF = 2:1$.



- The angle subtended by an arc at the centre of a circle is double the angle subtended by the same arc at any point on the remaining part of the circle.
 - Angles in the same segment of a circle are equal.
 - An angle in a semicircle is a right angle.
- If an arc of a circle subtends a right angle at any point on the remaining part of the circle, it is a semi circle.
- **Cyclic quadrilateral:** If all the four vertices of a quadrilateral lie on one circle, then the quadrilateral is called a cyclic quadrilateral.

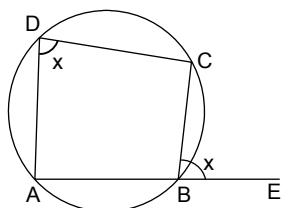


Note 1: Opposite angles in a cyclic quadrilateral are **supplementary**.

Note 2: In a quadrilateral, if the opposite angles are supplementary, then the quadrilateral is a cyclic quadrilateral.

In the above given figure, ABCD is a cyclic quadrilateral.

$$\angle A + \angle C = 180^\circ \text{ and } \angle B + \angle D = 180^\circ$$

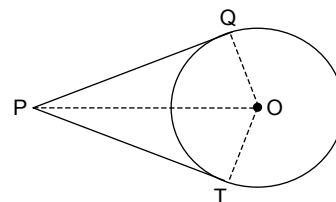


Note 3: Exterior angle of a cyclic quadrilateral is equal to the interior opposite angle.

In the figure, ABCD is a cyclic quadrilateral. AB is produced to E to form an exterior angle, $\angle CBE$ and it is equal to the interior angle at the opposite vertex, i.e., $\angle ADC$.

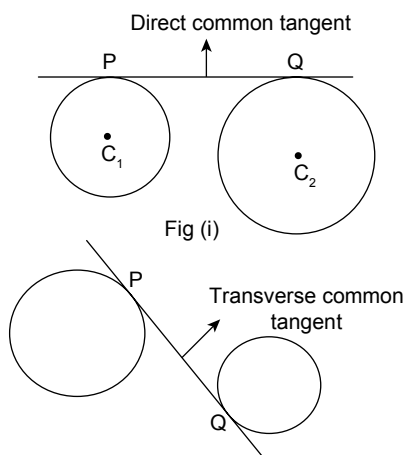
$$\therefore \angle CBE = \angle ADC$$

- Theorem 1: One and only one circle exists through three non-collinear points.
- Theorem 2: The perpendicular bisector of a chord of a circle passes through the centre of the circle.
- Theorem 3: Two equal chords of a circle are equidistant from the centre of the circle.
- Theorem 4: Equal chords subtend equal angles at the centre of the circle.
- Theorem 5: The opposite angles of a cyclic quadrilateral are supplementary.
- Theorem 6: The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle.
- Theorem 7: The tangent at any point on a circle is perpendicular to the radius through the point of contact.
- Theorem 8: Two tangents drawn to a circle from an external point are equal in length.



- Theorem 9: If two chords of a circle intersect each other, then the products of the lengths of their segments are equal.
- Theorem 10: Alternate segment theorem: If a line touches the circle at a point and if a chord is drawn from the point of contact then the angles formed between the chord and the tangent are equal to the angles in the alternate segments.
- Apollonius theorem: In a triangle, the sum of the squares of two sides of a triangle is equal to twice the sum of the square of the median which bisects the third side and the square of half the third side.
- **Common tangent:** If the same line is tangent to two circles drawn on the same plane, then the line is called a common tangent to the circles. The distance between the point of contacts is called the length of the common tangent.

In the figure, PQ is a common tangent to the circles, C_1 and C_2 . The length of PQ is the length of the common tangent.



In figure (i), we observe that both the circles lie on the same side of PQ. In this case, PQ is a **direct** common tangent and in figure (ii), we notice that the two circles lie on either side of PQ. Here PQ is a **transverse** common tangent.

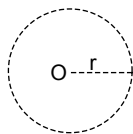
○ Locus

The collection (set) of all points and only those points which satisfy certain given geometrical conditions is called the **locus of a point** satisfying the given conditions.

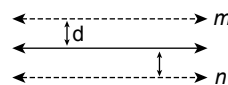
Alternatively, a **locus** can be defined as the path or curve traced by a point in a plane when subjected to some geometrical conditions.

Consider the Following Examples

1. The locus of the point in a plane which is at a constant distance r from a fixed point O is a circle with centre O and radius r units.



2.



The locus of the point in a plane which is at a constant distance from a fixed straight line (ℓ) is a pair of lines, parallel to ℓ , lying on either side of ℓ . Let the fixed line be ℓ . The lines m and n form the set of all points which are at a constant distance from ℓ .

Before proving that a given path or curve is the desired locus, it is necessary to prove the following.

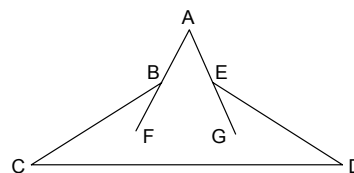
- (i) Every point lying on the path satisfies the given geometrical conditions.
- (ii) Every point that satisfies the given conditions lies on the path.

Some Important Points

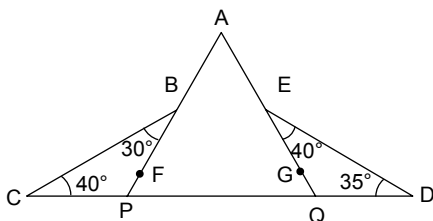
- (i) In an equilateral triangle, the centroid, the orthocentre, the circumcentre and the incentre coincide.
- (ii) In an isosceles triangle, the centroid, the orthocentre, the circumcentre and the incentre all lie on the median to the base, i.e., they are collinear.
- (iii) In a right-angled triangle the length of the median drawn to the hypotenuse is equal to half of the hypotenuse. The median is also equal to the circumradius. The mid-point of the hypotenuse is the circumcentre.
- (iv) In an obtuse-angled triangle, the circumcentre and orthocentre lie outside the triangle and for an acute-angled triangle the circumcentre and the orthocentre lie inside the triangle.
- (v) For all triangles, the centroid and the incentre lie inside the triangle.
- (vi) For all triangles, the excentre lies outside the triangle.

Solved Examples

1. In the above figure (not to scale), $\angle BCD = 40^\circ$, $\angle EDC = 35^\circ$, $\angle CBF = 30^\circ$ and $\angle DEG = 40^\circ$, find $\angle BAE$.

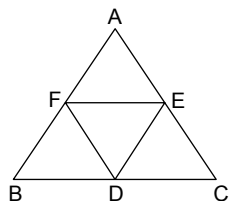


- Solution:** Given $\angle BCD = 40^\circ$, $\angle EDC = 35^\circ$
 $\angle CBF = 30^\circ$ and $\angle DEG = 40^\circ$
 Produce AF to meet CD at P and also produce AG to meet CD at Q.
 In $\triangle BPC$, $\angle BPQ = \angle CBP + \angle BCD$
 $(\because \text{exterior angle}) \Rightarrow \angle BPQ = 70^\circ$
 In $\triangle EQD$, $\angle EQP = \angle DEQ + \angle EQDQ$
 $(\because \text{exterior angle})$



$$\begin{aligned}
 &\Rightarrow \angle EQP = 40^\circ + 35^\circ \\
 &\Rightarrow \angle EQP = 75^\circ \\
 &\text{In } \triangle APQ, \angle PAQ + \angle APQ + \angle AQP \\
 &= 180^\circ \\
 &\Rightarrow \angle PAQ = 180^\circ - (70^\circ + 75^\circ) = 35^\circ. \\
 &\therefore \angle BAE = 35^\circ
 \end{aligned}$$

2. In the given triangle ABC, D, E and F are the mid-points of sides BC, CA and AB respectively. Prove that $\frac{AB-BC}{2} < AE < \frac{AB+BC}{2}$.



- Solution:** Difference of two sides is less than the third side.

$$\therefore AB - BC < AC$$

Since E is the mid-point of AC, $AE = AC/2$

$$AB - BC < 2AE$$

$$\frac{AB-BC}{2} < AE \quad \dots (1)$$

The sum of the two sides is greater than the third side.

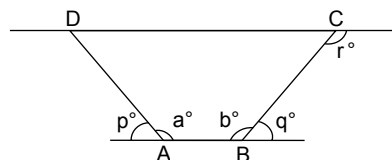
$$AB + BC > AC. AC = 2AE. AB + BC > 2AE$$

$$AE < \frac{AB+BC}{2} \quad \dots (2)$$

$$\text{From (1) and (2), } \frac{AB-BC}{2} < AE < \frac{AB+BC}{2}.$$

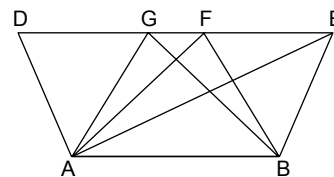
3. In the given quadrilateral ABCD, $p^\circ + q^\circ = 100^\circ$, $a^\circ = 140^\circ$ and $r^\circ = \frac{1}{2}(a^\circ + q^\circ)$. Find the angles p° , q° and r° .

- Solution:** $p^\circ + a^\circ = 180^\circ$



$$\begin{aligned}
 &\Rightarrow p + 140^\circ = 180^\circ \Rightarrow p = 40^\circ \\
 &\text{and given that } p + q = 100^\circ \\
 &\Rightarrow 40^\circ + q = 100^\circ \Rightarrow q = 60^\circ \\
 &\text{But } b^\circ + q = 180^\circ \Rightarrow b^\circ + 60^\circ = 180^\circ \\
 &\Rightarrow b^\circ = 120^\circ \\
 &\text{given } r = \frac{1}{2}(a + q) \Rightarrow r = \frac{1}{2}(140 + 60) \\
 &\Rightarrow r = 100^\circ
 \end{aligned}$$

4. In the given figure, $\overline{AB} \parallel \overline{DE}$ and area of the parallelogram ABFD is 24 cm^2 . Find the areas of $\triangle AFB$, $\triangle AGB$ and $\triangle AEB$.

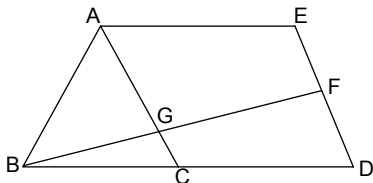


- Solution:** Given $\overline{AB} \parallel \overline{DE}$ and the area of parallelogram ABFD is 24 cm^2 .

$\triangle AFB$, $\triangle AGB$, $\triangle AEB$ and parallelogram ABFD are on the same base and between the same parallels.

$$\begin{aligned}
 \therefore \text{Area of } \triangle AFB &= \text{Area of } \triangle AGB \\
 &= \text{Area of } \triangle AEB \\
 &= \frac{1}{2} \times \text{area of parallelogram ABFD} \\
 &= \frac{1}{2} \times 24 = 12 \text{ cm}^2.
 \end{aligned}$$

5. In the given figure (not to scale), ABC is an isosceles triangle in which $AB = AC$. AEDC is a parallelogram. If $\angle CDF = 70^\circ$ and $\angle BFE = 100^\circ$, then find $\angle FBA$.



☞ **Solution:** Given, ABC is an isosceles triangle in which $AB = AC$.

AEDC is a parallelogram.

$\angle CDF = 70^\circ$ and $\angle BFE = 100^\circ$.

Since AEDC is a parallelogram,

$$\angle ACD + 70^\circ = 180^\circ$$

$$\Rightarrow \angle ACD = 110^\circ \rightarrow (1)$$

$$\angle ACD + \angle GCB = 180^\circ (\because \text{linear pair})$$

$$\Rightarrow \angle GCB = 180^\circ - 110^\circ = 70^\circ \rightarrow (2)$$

$$\angle GFD + \angle BFE = 180^\circ (\text{linear pair})$$

$$\Rightarrow \angle GFD = 180^\circ - 100^\circ = 80^\circ \rightarrow (3)$$

$$\text{In } \triangle BFD, \angle FBD = 180^\circ - (80^\circ + 70^\circ) = 30^\circ$$

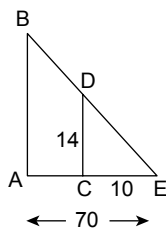
Since $AB = AC$, $\angle ABC = \angle ACB$

$$\therefore \angle ABC = 70^\circ$$

$$\Rightarrow \angle ABG = \angle ABC - \angle FBD = 70^\circ - 30^\circ = 40^\circ$$

6. A pole of height 14 m casts a shadow 10 m long on the ground. At the same time a tower casts the shadow 70 m long on the ground. Find the height of the tower.

☞ **Solution:** Let CD be the pole and AB be the tower.



$$\angle BAE = \angle DCE = 90^\circ$$

$$\therefore DC \parallel AB.$$

$$\therefore \triangle ABE \sim \triangle CDE \text{ (AAA)}$$

$$\Rightarrow \frac{CE}{AE} = \frac{CD}{AB} \Rightarrow \frac{10}{70} = \frac{14}{AB}$$

$$\Rightarrow AB = 98 \text{ m}$$

7. Find each interior and exterior angle of a regular polygon having 30 sides.

☞ **Solution:** The number of sides (n) = 30

Each interior angle of a regular polygon with ' n ' sides

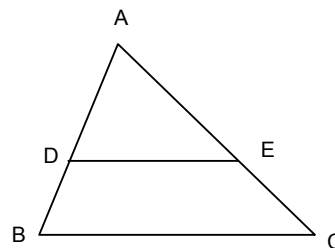
$$= \frac{(2n-4) \times 90^\circ}{n} = \frac{(60-4) \times 90^\circ}{30} = 56 \times 3$$

$$= 168^\circ$$

$$\text{Each exterior angle} = \frac{360^\circ}{n} = \frac{360^\circ}{30} = 12^\circ$$

8. In the following figure, $DE \parallel BC$, AD

$= 5.6$ cm, $AE = (x + 1)$ cm, $DB = 2.8$ cm and $EC = (x - 1)$ cm. Find x .



☞ **Solution:** $DE \parallel BC \Rightarrow \frac{AD}{DB} = \frac{AE}{EC}$

$$\Rightarrow \frac{AE}{EC} \Rightarrow \frac{5.6}{2.8} = \frac{x+1}{x-1} \Rightarrow 2 = \frac{x+1}{x-1}$$

$$\Rightarrow 2x - 2 = x + 1 \Rightarrow x = 3$$

9. One angle of a decagon is 90° and all the remaining nine angles are equal. What is the measure of the other angles?

☞ **Solution:** One angle of the decagon = 90°

The number of sides (n) = 10

The sum of interior angles = $(2n - 4) \times 90^\circ$

Let each of the other angles be equal to x°

$$9x + 90^\circ = (20 - 4) \times 90^\circ = 16 \times 90^\circ = 1440^\circ$$

$$9x = 1440^\circ - 90^\circ = 1350^\circ$$

$$x = \frac{1350^\circ}{9} = 150^\circ. \text{ Each of the other angles} = 150^\circ.$$

10. In the above figure (not to scale), E and D are the mid-points of AB and BC respectively. Also $\angle B = 90^\circ$, $AD = \sqrt{292}$ cm and $CE = \sqrt{208}$ cm. Find AC.

☞ **Solution:** In $\triangle ABD$, $AD^2 = AB^2 + BD^2$

$$\Rightarrow AD^2 = AB^2 + \left(\frac{BC}{2}\right)^2 \quad \dots (1)$$

(\because D is the mid-point of BC)

$$\text{In } \triangle BEC, CE^2 = BC^2 + BE^2$$

$$\Rightarrow CE^2 = BC^2 + \left(\frac{AB}{2}\right)^2 \quad (2)$$

(\because E is mid-point of AB)

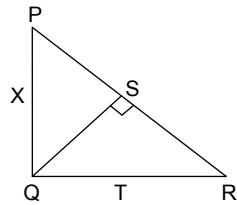
Adding (1) and (2), we get,

$$\Rightarrow 292 + 208 = \frac{5}{4}(AB^2 + BC^2)$$

$$\Rightarrow 400 = AB^2 + BC^2 \Rightarrow 400 = AC^2$$

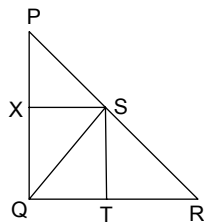
$$\Rightarrow AC = 20 \text{ cm}$$

11. In the following figure, angle PQR = 90° , and SQ is perpendicular to PR. Show that $QR^2 \times PS^2 = PQ^2 \times QR^2$.



Solution: Given that PQR is a right angled triangle and QS is perpendicular to PR. $\triangle PQR$ and $\triangle PSQ$ are similar.

$$\frac{PQ}{PS} = \frac{PR}{PQ} \Rightarrow PQ^2 = PR \times PS$$



$$\Rightarrow PS = \frac{PQ^2}{PR} \quad \dots\dots (1)$$

$$\text{In } \triangle PQR \text{ and } \triangle QSR, \frac{QR}{RS} = \frac{PR}{QR}$$

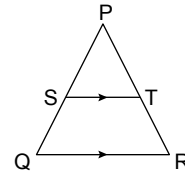
$$\Rightarrow QR^2 = PR \times RS \Rightarrow RS = \frac{QR^2}{PR} \quad \dots (2)$$

$$\text{and in } \triangle PQR, QS^2 = PS \times SR \quad \dots (3)$$

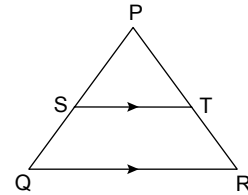
$$\text{Substitute (1) and (2) in (3), } QS^2 = \frac{PQ^2}{PR} \times \frac{QR^2}{PR}$$

$$QS^2 \times PR^2 = PQ^2 \times QR^2. \text{ Hence proved.}$$

12. In a triangle PQR, ST is parallel to QR. Show that $RT(PQ + PS) = SQ(PR + PT)$.



Solution: PQR is a triangle. ST is parallel to QR.



By basic proportionality theorem, in $\triangle PQR$.

$$\frac{PQ}{PS} = \frac{PR}{PT}$$

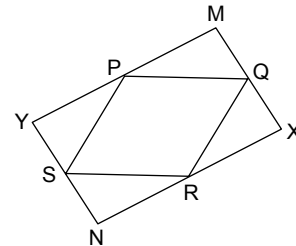
By componendo and dividendo,

$$\frac{PQ}{PS} = \frac{PR}{PT} \Rightarrow \frac{PQ + PS}{PQ - PS} = \frac{PR + PT}{PR - PT}$$

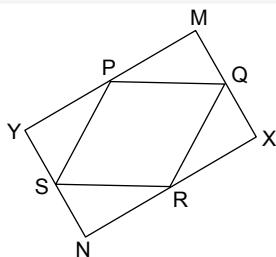
$$\frac{PQ + PS}{SQ} = \frac{PR + PT}{TR}$$

$$RT(PQ + PS) = SQ(PR + PT)$$

13. In the following figure, PQRS is a rhombus formed by joining the mid-points of a quadrilateral YMXN, show that $3PQ^2 = SN^2 + NR^2 + QX^2 + XR^2 + PY^2 + YS^2$.



Solution: Given that, PQRS is a rhombus formed by joining mid-points of the sides of the quadrilateral YMXR.



∴ YMXR is a rectangle.

⇒ $\angle Y = \angle M = \angle X = \angle R = 90^\circ$

In triangle SNR, $SN^2 + NR^2 = SR^2$

In triangle QXR, $QX^2 + XR^2 = QR^2$

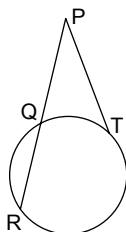
In triangle PYS, $PY^2 + YS^2 = PS^2$

Since PQRS is a rhombus, $PQ = RQ = RS = SP$

$SR^2 + QR^2 + PS^2 = 3PQ^2$

⇒ $3PQ^2 = SN^2 + NR^2 + QX^2 + XR^2 + PY^2 + YS^2$

14. In the following figure, PR is a secant and PT is a tangent to the circle. If $PT = 6$ cm and $QR = 5$ cm, then $PQ =$ _____ cm.



☞ **Solution:** PQR is a secant, PT is a tangent
 ∴ $PQ \times PR = PT^2$ (1)

Given, $PT = 6$, $QR = 5$

Let $PQ = x$

∴ $PR = PQ + QR = x + 5$

from (1)

$$PQ \times PR = PT^2$$

$$x(x + 5) = 6^2$$

$$x^2 + 5x = 36$$

$$x^2 + 5x - 36 = 0$$

$$(x + 9)(x - 4) = 0$$

$$x + 9 = 0; x - 4 = 0$$

$$x = -9; x = 4$$

Since length is always positive

∴ $x = PQ = 4$ cm

15. Find the locus of a point which is at a distance of 5 units from $(-1, -2)$.

☞ **Solution:** Let $P(x, y)$ be any point on locus and the given point be $A(-1, -2)$

Given that, $AP = 5$ units.

$$\text{i.e., } \sqrt{(x - (-1))^2 + (y - (-2))^2} = 5$$

$$\Rightarrow \sqrt{(x + 1)^2 + (y + 2)^2} = 5$$

$$\Rightarrow x^2 + 2x + 1 + y^2 + 4y + 4 = 5$$

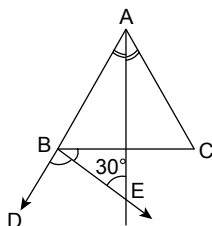
$$\Rightarrow x^2 + y^2 + 2x + 4y = 0$$

∴ The required locus is $x^2 + y^2 + 2x + 4y = 0$.

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1.



In the above figure, AB is produced to D. The bisectors of $\angle DBC$ and $\angle BAC$ meet at E. Find $\angle ACB$, if $\angle BEA = 30^\circ$.

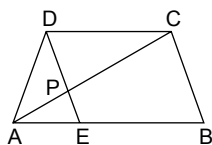
- (1) 45° (2) 60°
(3) 75° (4) 90°

2. In a triangle ABC, AD, BE and CF are the altitudes. Find the value of

$$\frac{AD^2 + BE^2 + CF^2 - (AF^2 + BD^2 + CE^2)}{CD \cdot DB + BF \cdot FA + AF \cdot FB}$$

- (1) 1 (2) 2
(3) 3 (4) 4

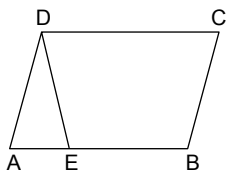
3.



In the figure above, ABCD is a trapezium and DEBC is a parallelogram such that $AD = DE$, $\angle DAP = 40^\circ$ and $\angle ABC = 75^\circ$. If AC and DE intersect at P, then find $\angle PCD$.

- (1) 35° (2) 30°
(3) 40° (4) 45°

4.



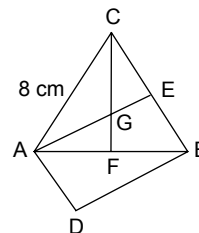
In the figure above, ABCD is a parallelogram and $\angle DEB = \angle CBE$. If $\angle ADE = 40^\circ$, then find $\angle ABC$.

- (1) 100° (2) 90°
(3) 80° (4) 110°

5. In a $\triangle ABC$, if $\angle B = 90^\circ$ and D is a point on AC such that $BD \perp AC$. Then $AB^2 =$

- (1) $BC \times BD$ (2) $BC \times CD$
(3) $AC \times BD$ (4) $AC \times AD$

6.



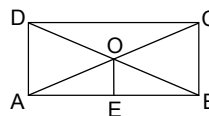
In the figure above, ABC is a triangle. AE and CF are the medians and ADBE is a rectangle. If $AC = 8$ cm and $BE = 4$ cm, then the length of BD is

- (1) $3\sqrt{3}$ (2) $4\sqrt{3}$
(3) $5\sqrt{2}$ (4) $3\sqrt{2}$

7. ABCD is a rhombus in which $\angle DAC = 30^\circ$. P is a point on \overline{CD} and \overline{BP} is perpendicular to CD. AC and BP intersect at T. If $BD = 6$ cm, then find the length of BT.

- (1) $2\sqrt{2}$ (2) $2\sqrt{3}$
(3) $3\sqrt{2}$ (4) $3\sqrt{3}$

8.



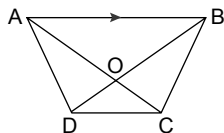
In the given rectangle ABCD, the sum of the lengths of two diagonals is equal to 52 cm and E is a point on AB such that \overline{OE} is perpendicular to \overline{AB} . Find the area of the rectangle (in cm^2), if $OE = 5$ cm.

- (1) 120 (2) 240
(3) 260 (4) 90

9. In a $\triangle ABC$, E and F are points on the sides AB and AC respectively. If $AE = 3$ cm, $AF = 4$ cm, $EB = 9$ cm and $FC = 12$ cm, then find EF in terms of BC.

- (1) $\frac{BC}{2}$ (2) $\frac{BC}{3}$
(3) $\frac{BC}{4}$ (4) $\frac{BC}{5}$

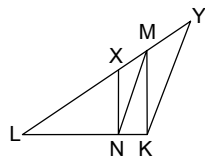
10.



In the following figure, show that area of $\triangle DCO$: area of $\triangle COB$ =

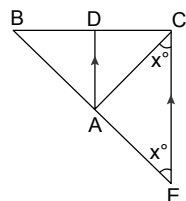
- (1) $OD:OC$ (2) $OC:OB$
 (3) $OD:OB$ (4) $BC:CD$

11. In the following figure, if \overline{XN} is parallel to \overline{MK} and \overline{MN} is parallel to \overline{KY} . Then $(LX)(MY) =$



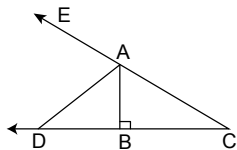
- (1) $(LM)(MX)$ (2) $(LM)(MN)$
 (3) $(NK)(MK)$ (4) $(NK)(LN)$

12. In the following figure, \overline{CE} is parallel to \overline{AD} and angle $AEC = x^\circ =$ angle ACE . If BEC is a triangle, Then $AB \times CD =$



- (1) $BC \times DE$ (2) $BC \times CE$
 (3) $AB \times BC$ (4) $AC \times BC$

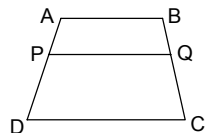
13.



In the figure above (not to scale), $\overline{AB} \perp \overline{CD}$ and \overline{AD} is the bisector of $\angle BAE$. $AB = 3$ cm and $AC = 5$ cm. Find CD (in cm).

- (1) 10 (2) 12
 (3) 15 (4) 18

14.



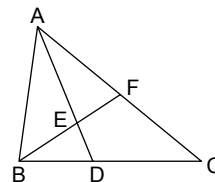
In the figure above (not to scale), $ABCD$ is an isosceles trapezium. $\overline{AB} \parallel \overline{CD}$, $AB = 9$ cm and $CD = 12$ cm. $AP:PD = BQ:QC = 1:2$. Find the length of PQ (in cm).

- (1) 8 (2) 9
 (3) 6 (4) 10

15. In a $\triangle PQR$, M lies on PR and between P and R such that $QR = QM = PM$. If $\angle MQR = 40^\circ$, then find $\angle P$.

- (1) 45° (2) 40°
 (3) 35° (4) 50°

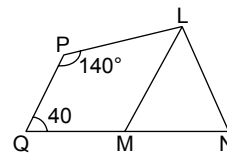
16.



In the figure given a triangle ABC with, $AE = 3ED$, $2BD = DC$ and $\sqrt{2}AB = AC$. If $AB = 3BD$. Find $\angle ABC$.

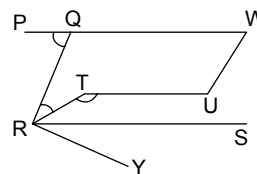
- (1) 90° (2) 70°
 (3) 80° (4) 72°

17. In the figure below, $LM = LN$ and $\angle PLN = 130^\circ$. Find $\angle MLN$.



- (1) 70° (2) 80°
 (3) 85° (4) 90°

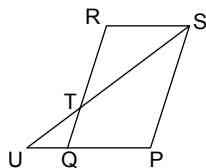
18.



In the figure above, $TU \parallel RS$. Find $\angle WUT$, given $\angle PWU = 50^\circ$, $\angle PQR = 70^\circ$, $\angle QRT = 10^\circ$ and $\angle UTR = 120^\circ$.

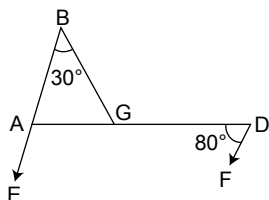
- (1) 110° (2) 120°
 (3) 130° (4) 140°

19. $PQRS$ is a parallelogram. T is a point on QR satisfying $QT = \frac{QR}{3}$. If PQ and ST are produced to meet at U , as shown in the figure, then $PU =$



- (1) $4UQ$ (2) $3UQ$
 (3) $\frac{5}{2}UQ$ (4) $\frac{7}{2}UQ$

20. In the given figure, BE is parallel DF. Find $\angle AGB$.

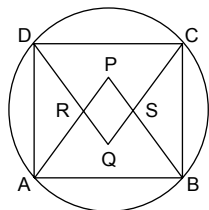


- (1) 70° (2) 75°
 (3) 80° (4) 90°

21. Two parallel chords of equal length 18 cm are drawn inside a circle of radius 15 cm. Find the distance between the chords.

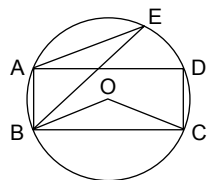
- (1) 12 cm (2) 18 cm
 (3) 24 cm (4) 30 cm

22. In the given figure, ABCD is a cyclic quadrilateral. AP, BP, CQ, DQ are the bisectors of angles A, B, C and D. The sum of the angles PRQ and PSQ is _____.



- (1) 90° (2) 120°
 (3) 180° (4) Data insufficient

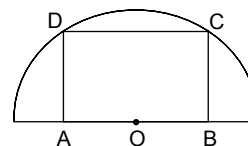
23.



In the figure above, rectangle ABCD and triangle ABE are inscribed in the circle with centre O. If $\angle AEB = 40^\circ$, then find $\angle BOC$.

- (1) 100° (2) 60°
 (3) 120° (4) 80°

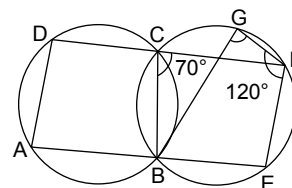
24.



In the figure above, ABCD is a rectangle inscribed in a semi circle. If the length and the breadth of the rectangle are in the ratio 2: 1. What is the ratio of the perimeter of the rectangle to the diameter of the semicircle?

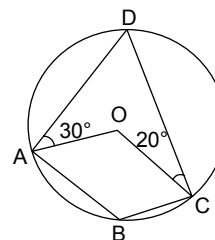
- (1) $\sqrt{3} : \sqrt{2}$ (2) $3 : \sqrt{2}$
 (3) $2 : \sqrt{3}$ (4) $\sqrt{3} : 2$

25. In the figure given below, if $\angle BCF = 70^\circ$ and $\angle EFG = 120^\circ$, then find the value of $\angle BAD + \angle ABG + \angle BGF$.



- (1) 260° (2) 360°
 (3) 180° (4) 150°

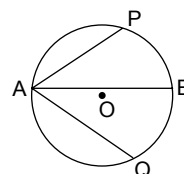
26.



In the figure above, ABCD is a cyclic quadrilateral. O is the centre of the circle. If $\angle OAD = 30^\circ$ and $\angle OCD = 20^\circ$, then find $\angle ABC$.

- (1) 120° (2) 50°
 (3) 130° (4) 80°

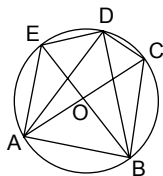
27.



In the figure above, AB is a diameter of the circle with the centre O. AP and AQ are equal chords. If $\angle PAQ = 80^\circ$, then find $\angle APO$.

- (1) 45° (2) 40°
(3) 80° (4) 100°

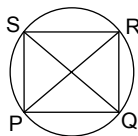
28.



In the figure above, A, B, C, D and E are concyclic points. O is the centre of the circle. $\angle EAD = 25^\circ$ and $\angle CBD = 20^\circ$. Find $\angle EDC$.

- (1) 145° (2) 180°
(3) 135° (4) 85°

29.



In the figure above, PQRS is a cyclic quadrilateral and PR is a diameter. If $\angle RPQ = 50^\circ$ and $\angle SQP = 45^\circ$, then find $\angle QRS$.

- (1) 85° (2) 90°
(3) 60° (4) 100°

30. Let A and B be two fixed points in a plane. Find the locus of a point P such that $PA^2 + PB^2 = AB^2$.

- (1) Right triangle
(2) Circle with out A and B
(3) Semicircle with out A and B
(4) Square

31. Find the locus of the vertex of triangle with fixed base and having constant area.

- (1) line parallel to the base
(2) circumcircle
(3) incircle
(4) the vertex

32. P is the point of intersection of the diagonals of a square READ. P is equidistant from

- (1) the vertices R, E, A and D.
(2) \overline{RE} and \overline{EA} .
(3) \overline{EA} and \overline{AD} .
(4) All of these

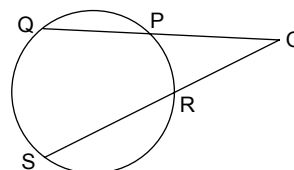
33. In a triangle ABC, D is a point on BC such that any point on AD is equidistant from the points B and C. Which of the following is necessarily true?

- (1) $AB = BC$ (2) $BC = AC$
(3) $AC = AB$ (4) $AB = BC = AC$

34. In a $\triangle ABC$, $AB = AC$. P, Q and R are the mid-points of the sides AB, BC and CA respectively. A circle is passing through A, B, Q and R. Another circle is passing through A, P, Q and C. If $AC = 6$ cm, then find the distance between the centres of the circles.

- (1) 4 cm (2) 3 cm
(3) 5 cm (4) 2 cm

35.



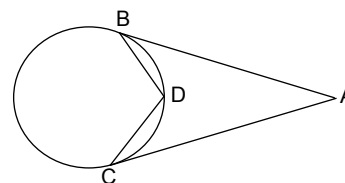
In the figure above (not to scale), QP and SR are two chords of the circle, produced to meet at the point O. $OR = 3$ cm, $SR = 3x$ cm, $OP = (x + 1)$ cm and $PQ = (x + 2)$ cm. Find x.

- (1) 3 (2) 6
(3) 9 (4) 12

36. In a triangle ABC, P and Q are the points on BC and AC respectively. If $BP : PC = 2 : 3$ and $\overline{PQ} \parallel \overline{AB}$, then find $AQ : AC$.

- (1) 2 : 3
(2) 2 : 5
(3) 3 : 5
(4) None of these

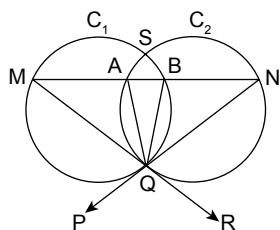
37.



In the figure above (not to scale), AB and AC are two tangents drawn to a circle at B and C respectively, $\angle DCA = 35^\circ$ and $\angle DBA = 40^\circ$. Find the measure of $\angle BAC$.

- (1) 15° (2) 30°
(3) 45° (4) 60°

38.



In the figure above (not to scale), two circles C_1 and C_2 intersect at S and Q . PQN and RQM are tangents drawn to C_1 and C_2 respectively at Q . MAB and ABN are the chords of the circles C_1 and C_2 . If $\angle NQR = 85^\circ$, then find $\angle AQB$.

- (1) 10° (2) 15°
(3) 20° (4) 25°

39. Radii of two concentric circles are 40 cm and 41 cm. AB is a chord of the bigger circle and tangent to the smaller circle. Find the length of AB .

- (1) 9 (2) 18
(3) 13 (4) 26

40. In $\triangle ABC$, $\angle ABC = 90^\circ$, $AB = 3$ cm and $BC = 4$ cm. If $\overline{BD} \perp \overline{AC}$ where D is a point on \overline{AC} , then find BD .

- (1) 2.4 cm (2) 3.6 cm
(3) 4.8 cm (4) 1.2 cm

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

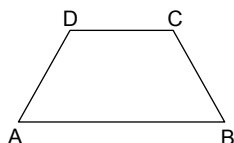
1. The perpendicular bisectors of AB and AC of the triangle ABC meet BC at D . If the bisectors meet AB at P and AC at Q , then find $\angle BDP + \angle CDQ$.

- (1) 80° (2) 90°
(3) 60° (4) 100°

2. In $\triangle ABC$, D , E and F are the mid-points of BC , CA and AB respectively. $\frac{(AB + BE + CF)}{(AB + BC + CA)}$ is

- (1) $> \frac{3}{4}$ (2) $< \frac{1}{2}$
(3) $< \frac{3}{5}$ (4) $< \frac{3}{4}$

3.



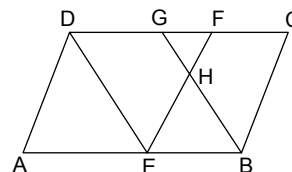
In the figure above (not to scale), $ABCD$ is a trapezium in which $\overline{AB} \parallel \overline{CD}$, $AD = CD$ and $AB = 2CD$. If $\angle ADC = 100^\circ$, then find $\angle ABC$.

- (1) 40° (2) 50°
(3) 60° (4) 70°

4. $ABCD$ is an isosceles trapezium in which $\overline{AB} \parallel \overline{CD}$. If the bisectors of $\angle BAD$ and $\angle ADC$ intersect at P . Find $\angle APD$.

- (1) 45° (2) 60°
(3) 90° (4) 120°

5.



In the figure above, $ABCD$ is a parallelogram \overline{DE} , \overline{EF} and \overline{BG} are the bisectors of $\angle ADC$, $\angle DEB$ and $\angle ABC$ respectively. BG and EF intersect at H . If $\angle DAB = 70^\circ$, then find $\angle BHE$.

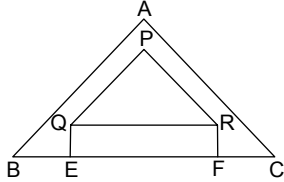
- (1) 50° (2) $\left(62\frac{1}{2}\right)^\circ$
(3) 75° (4) $\left(87\frac{1}{2}\right)^\circ$

6. Match the Column A with Column B.

Column A (Name of the polygon)	Column B (Number of diagonals)
(a) Octagon	() (p) 5
(b) Decagon	() (q) 9
(c) Pentagon	() (r) 10
(d) Hexagon	() (s) 15
	() (t) 20
	(u) 35

- (1) (a) \rightarrow t, (b) \rightarrow u, (c) \rightarrow p, (d) q
 (2) (a) \rightarrow t, (b) \rightarrow u, (c) \rightarrow P, (d) r
 (3) (a) \rightarrow t, (b) \rightarrow u, (c) q, (d) r
 (4) None of these

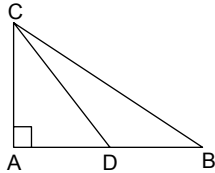
7.



In the figure above, $AC = 4$ cm, $PR = 2.5$ cm and $QR = 4$ cm. If $AB \parallel PQ$, $BC \parallel QR$, $AC \parallel PR$ and $QE \parallel RF$, then find the length of $BE + FC$.

- (1) 2.4 cm (2) 3.6 cm
 (3) 4.8 cm (4) 6 cm

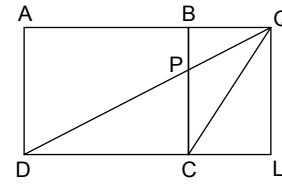
8.



In the above figure $\triangle ABC$ is a right triangle. $\angle A = 90^\circ$ and CD is the median then $BC^2 - CD^2 =$ _____.

- (1) $\frac{1}{2}AB^2$ (2) $\frac{3}{2}AB^2$
 (3) $\frac{3}{4}AB^2$ (4) $\frac{1}{4}AB^2$

9. If the sides AB , BC , CD and DA of a trapezium $ABCD$ measure 10 cm, 20 cm, 18 cm and 16 cm respectively, then find the length of the longer diagonal, given that AB is parallel to CD .
- (1) $\sqrt{760}$ (2) $\sqrt{231}$
 (3) $\sqrt{54}$ (4) $\sqrt{930}$
10. PQR is a right triangle. The length of its greatest side is $24\sqrt{3}$ cm. Find the length of the line segment joining the vertex of the right angle and the mid-point of the greatest side (in cm).
- (1) $6\sqrt{3}$ (2) $9\sqrt{3}$
 (3) $12\sqrt{3}$ (4) $18\sqrt{3}$
11. In the figure, $ABCD$ is a parallelogram. P is the point on BC such that $BP/PC = 1/4$ and DP is produced to meet AB produced at Q . The area of triangle BPQ = times of (area of triangle CPD).

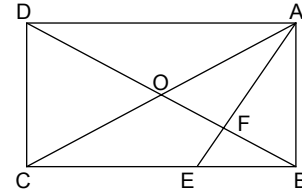


- (1) $1/4$ (2) $1/8$
 (3) $1/16$ (4) $1/32$

12. The distance between two buildings is 24 m. The heights of the buildings are 12 m and 22 m. Find the distance between the tops (in m).

- (1) 20 (2) 26
 (3) 30 (4) 32

13.



In the figure above (not to scale), $ABCD$ is a rectangle with diagonals intersecting at O . If $OA = AB$ and $\angle AEC = 120^\circ$, then $\angle OAF =$ _____.

- (1) 30° (2) 45°
 (3) 50° (4) Cannot be determined

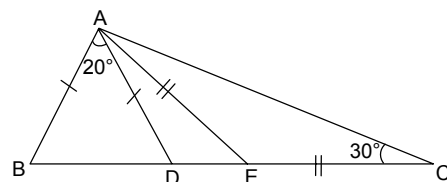
14. Diagonal AC of a rectangle $ABCD$ is produced to the point E such that $AC:CE = 2:1$. $AB = 8$ cm and $BC = 6$ cm. Find the length of DE (in m)

- (1) $\sqrt{17}$ (2) $3\sqrt{17}$
 (3) $2\sqrt{17}$ (4) $4\sqrt{17}$

15. In $\triangle PQR$, $PQ = 6$ cm, $PR = 9$ cm and M is a point on QR such that it divides QR in the ratio 1:2. $PM \perp QR$. Find the length of QR .

- (1) $\sqrt{15}$ (2) $2\sqrt{15}$
 (3) $3\sqrt{15}$ (4) $4\sqrt{15}$

16. In the given figure ABC and ADE are triangles such that $AB = AD$, $AE = EC$. Find the measure of angle DAE .

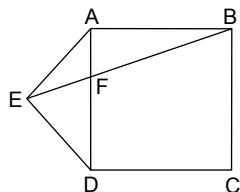


- (1) 10° (2) 20°
 (3) 25° (4) 15°

17. In a right angled triangle ABC, $AB = 10\sqrt{3}$ cm and $BC = 20$ cm, $\angle A = 90^\circ$. An equilateral triangle ABD is constructed with base AB and with vertex D, at a maximum possible distance from C. Find the length of CD.

- (1) $10\sqrt{7}$ cm (2) $10\sqrt{11}$ cm
(3) $10\sqrt{12}$ cm (4) $10\sqrt{14}$ cm

18.



In the above figure, ABCD is a square and triangle ADE is equilateral. Find $\angle EFD$.

- (1) 65° (2) 70°
(3) 80° (4) 75°

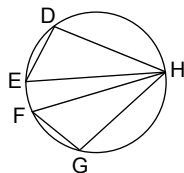
19.



In the figure above, AB is parallel to CD and $AD = BC$. If $\angle DAB = 100^\circ$, find $\angle BCD$

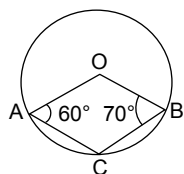
- (1) 80° (2) 60°
(3) 70° (4) 50°

20. In the given figure, \overline{DE} and \overline{FG} are equal chords of the circle subtending $\angle DHE$ and $\angle FHG$ at the point H on the circle. If $\angle DHE = 23\frac{1}{2}^\circ$, then find $\angle FHG$.



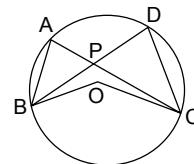
- (1) $(11\frac{3}{4})^\circ$ (2) 30°
(3) $(23\frac{1}{2})^\circ$ (4) 47°

21. In the given figure, O is the centre of the circle and $\angle OAC = 60^\circ$ and $\angle OBC = 70^\circ$. Find $\angle AOB$.



- (1) 130° (2) 80°
(3) 65° (4) 100°

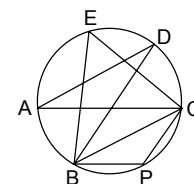
22.



In the given figure (not to scale), O is the centre of the circle. AC and BD intersect at P. $PB = PC$, $\angle PBO = 25^\circ$ and $\angle BOC = 130^\circ$, then find $\angle ABP + \angle DCP$.

- (1) 15° (2) 30°
(3) 45° (4) None of these

23.

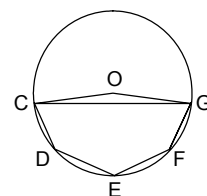


In the figure above (not to scale), AC is the diameter of the circle and $\angle ADB = 20^\circ$, then find $\angle BPC$.

- (1) 80° (2) 90°
(3) 100° (4) 110°

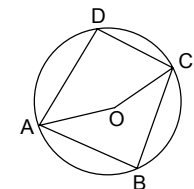
24. In the figure given below, O is the centre of the circle and $CD = DE = EF = GF$.

If $\angle COD = 40^\circ$, then find reflex $\angle COG$.



- (1) 200° (2) 220°
(3) 250° (4) 280°

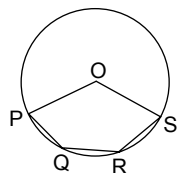
25.



In the figure above, ABCD is a cyclic quadrilateral and O is the centre of the circle. B, O and D are collinear points. If $\angle ABC = 70^\circ$ and $\angle OAD = 50^\circ$, then find $\angle OCB$.

- (1) 15° (2) 20°
 (3) 30° (4) 45°

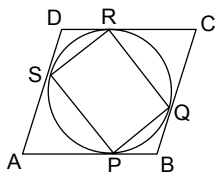
26.



In the figure above P, Q, R and S are concyclic points. O is the centre of the circle $PQ = QR = RS$. If $\angle OPS = 15^\circ$, then find $\angle OQR$.

- (1) 50° (2) 55°
 (3) 60° (4) 65°

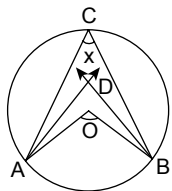
27.



In the figure above, a circle is inscribed in a parallelogram ABCD. PQRS is also a parallelogram and $\overline{AB} \perp \overline{PR}$. If $\angle SRP = 60^\circ$, then find $\angle BPQ$.

- (1) 60° (2) 45°
 (3) 30° (4) 25°

28.



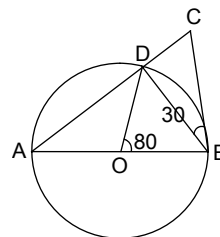
In the figure above, O is the centre of the circle. A, B and C are the points on the circle \overline{AD} and \overline{BD} are the angle bisectors of $\angle OAC$ and $\angle OBC$ respectively. If $\angle ACB = x$ and $\angle ADB = y$, then $x : y$

- (1) 3: 2 (2) 2: 3
 (3) 1: 2 (4) 2: 1

29. ABCD is a parallelogram. A circle is passing through B, C, D and intersecting AB at E. If $\angle DAE = 65^\circ$, then find $\angle CDE$.

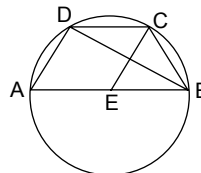
- (1) 65° (2) 50°
 (3) 55° (4) 40°

30. In the figure given below, if O is the centre of the circle, AB is the diameter and AD is produced to the point C, then find $\angle ACB$.



- (1) 15° (2) 30°
 (3) 45° (4) 60°

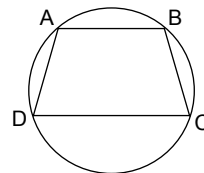
31.



In the figure above, ABCD is a trapezium in which $\overline{AB} \parallel \overline{DC}$. E is the centre of the circle. If $AD = EC$, then find $\angle BDC$.

- (1) 15° (2) 20°
 (3) 25° (4) 30°

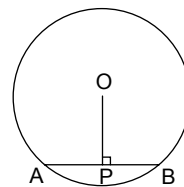
32. In the given figure, ABCD is a cyclic quadrilateral and $AD = BC$. If $\angle A = 110^\circ$, then find $\angle B$.



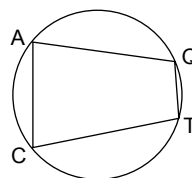
- (1) 70° (2) 80°
 (3) 100° (4) 110°

33. In the given figure, O is the centre of the circle. If $OP = 3$ cm and radius of the circle is 5 cm, then find the length of AB.

- (1) 8 cm (2) 6 cm
 (3) 4 cm (4) 2 cm



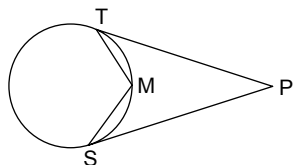
34.



In the figure above, $AQ = CT$ and $\angle QAC = 70^\circ$. Find $\angle ACT$.

- (1) 70° (2) 80°
(3) 90° (4) 110°

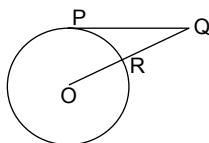
35.



In the figure above (not to scale), PT and PS are tangents segments drawn to a circle at T and S respectively. TM and SM are chords of the circle. If $\angle TMS = 100^\circ$, then find the angle between the tangents.

- (1) 10° (2) 15°
(3) 20° (4) 25°

36.



In the figure above (not to scale), PQ is a tangent, drawn to the circle with centre O at P and $QR = RO$. If $PQ = 3\sqrt{3}$ cm, and ORQ is a line segment, then find the radius of the circle. (in cm).

- (1) $\sqrt{3}$ (2) $2\sqrt{3}$
(3) 3 (4) $3\sqrt{3}$

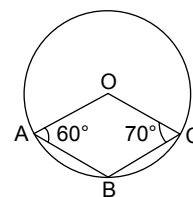
37. P , Q and R are on AB , BC and AC of the equilateral triangle ABC respectively. $AP:PB = CQ:QB = 1:2$. G is the centroid of the triangle PQB and R is the mid-point of AC . Find $BG:GR$.

- (1) $4:3$ (2) $3:4$
(3) $5:4$ (4) $4:5$

38. Three congruent circles of radius r units are inscribed in an equilateral triangle in such way that, each circle touches two sides of the triangle. Each circle also touches the other two circles. Find the length of side of the triangle (in units).

- (1) $(\sqrt{3}+1)$ (2) $2(\sqrt{3}+1)$
(3) $3(\sqrt{3}+1)$ (4) $4(\sqrt{3}+1)$

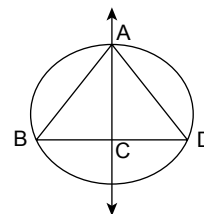
39.



In the figure above (not to scale), O is the centre of the circle, $\angle OAB = 60^\circ$ and $\angle OCB = 70^\circ$. Then find the $\angle AOC$.

- (1) 150° (2) 120°
(3) 100° (4) 80°

40. The following figure shows that $\triangle ABD$ is symmetrical figure about the line AC . If $\angle ABD = 60^\circ$, then $\angle BAD =$ _____.



- (1) 60° (2) 80°
(3) 100° (4) C an

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 1 | 4. 4 | 5. 4 | 6. 2 | 7. 2 | 8. 2 | 9. 3 | 10. 3 |
| 11. 1 | 12. 4 | 13. 1 | 14. 4 | 15. 3 | 16. 1 | 17. 2 | 18. 3 | 19. 2 | 20. 1 |
| 21. 3 | 22. 3 | 23. 1 | 24. 2 | 25. 1 | 26. 3 | 27. 2 | 28. 3 | 29. 1 | 30. 2 |
| 31. 1 | 32. 4 | 33. 3 | 34. 2 | 35. 1 | 36. 2 | 37. 2 | 38. 1 | 39. 2 | 40. 1 |

PRACTICE EXERCISE 3 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 1 | 3. 2 | 4. 3 | 5. 2 | 6. 1 | 7. 1 | 8. 3 | 9. 1 | 10. 3 |
| 11. 3 | 12. 2 | 13. 1 | 14. 2 | 15. 3 | 16. 2 | 17. 1 | 18. 4 | 19. 1 | 20. 3 |
| 21. 4 | 22. 2 | 23. 4 | 24. 1 | 25. 3 | 26. 4 | 27. 3 | 28. 2 | 29. 1 | 30. 4 |
| 31. 4 | 32. 4 | 33. 1 | 34. 1 | 35. 3 | 36. 3 | 37. 4 | 38. 2 | 39. 3 | 40. 1 |

Mensuration

SYNOPSIS

- Mensuration is the branch of geometry that deals with the measurement of length, area and volume.

Triangles

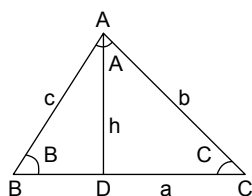


Fig. 1

- (i) For any triangle,
- When the measurements of sides a , b , c are given, area = $\sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{a+b+c}{2}$
 - When height and base are given,
Area = $\frac{1}{2} \times \text{Base} \times \text{Altitude} = \frac{1}{2} b.h$
 - Area = $\frac{1}{2} ab.\sin C = \frac{1}{2} bc.\sin A = \frac{1}{2} ca.\sin B$
 - Area = $\frac{abc}{4R}$ where R is the circumradius.
 - Area = $s.r$ where r is the inradius.
- (ii) For a right angled triangle, area = $\frac{1}{2} \times \text{Product of the sides containing the right angle.}$

- (iii) For an equilateral triangle, area = $\frac{\sqrt{3}a^2}{4}$, where “ a ” is the side of the triangle.
(Height of an equilateral triangle = $\frac{\sqrt{3}a}{2}$)
- (iv) For an isosceles triangle where “ a ” is length of two sides which are equal and b is the third side.
Area = $\frac{b}{4}\sqrt{4a^2 - b^2}$
- (v) Inradius of an equilateral triangle(r) = $\frac{a}{2\sqrt{3}}$ units.
- (vi) Circumradius of an equilateral triangle is
(R) = $\frac{a}{\sqrt{3}}$ units.

Quadrilaterals

- (i) For any quadrilateral
- Area = $\frac{1}{2} \times \text{one diagonal} \times \text{sum of offsets (or perpendiculars) drawn to this diagonal from the two opposite vertices} = \frac{1}{2} \times BC \times (AE + DF)$
 - Area = $\frac{1}{2} \times \text{Product of diagonals} \times \text{Sine of the angle between them} = \frac{1}{2} \cdot AD \cdot BC \cdot \sin \theta$
- (ii) For a cyclic quadrilateral,
Area = $\sqrt{(s-a)(s-b)(s-c)(s-d)}$ where s is the semi-perimeter, i.e., $s = \frac{(a+b+c+d)}{2}$
- (iii) For a trapezium, area = $\frac{1}{2} \times \text{Sum of parallel sides} \times \text{height}$

- (iv) For a parallelogram
 - (a) Area = Base \times Height
 - (b) Area = Product of two sides \times Sine of included angle
- (v) For a rhombus,
 - Area = $\frac{1}{2} \times$ Product of the diagonals
- (vi) For a rectangle, Area = Length \times Breadth
- (vii) For a square
 - (a) Area = Side²
 - (b) Area = $\frac{1}{2} \times$ Diagonal²
[Diagonal = $\sqrt{2} \times$ Side]
- (viii) For a Polygon
 - (a) Area of a regular Polygon = $\frac{1}{2} \times$ Height \times Perimeter of the polygon (where height is the perpendicular distance from the centre to any side. Please note that the centre of a regular polygon is equidistant from all its sides)
 - (b) For a polygon which is not regular, the area has to be found out by dividing the polygon into suitable number of quadrilaterals and triangles and adding up the areas of all such figures present in the polygon.

Circle

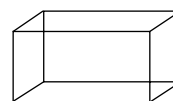
- (i) Area = πr^2 , where r is the radius of the circle.
Circumference = $2\pi r$
 - (ii) Sector of a circle:
 - Area (A) = $\frac{\theta}{360^\circ} \times \pi r^2$ where θ is the angle of the sector and r is the radius of the circle.
 - Length of arc (ℓ) = $\frac{\theta}{360^\circ} \times 2\pi r$
 - Note: $A = \frac{\ell r}{2}$
 - (iii) Perimeter of sector = $\ell + 2r$ units.
 - (iv) Circular ring: Area = $\pi R^2 - \pi r^2 = \pi(R + r)(R - r)$, where R = Radius of outer circle and r = Radius of inner circle.
- **Prism:** A right prism is a solid whose top and bottom faces (called base) are parallel to each other and are identical polygons of any number of sides that are parallel. The faces joining the two bases are rectangles and are called lateral faces. There are as many lateral faces as there are sides in each of the bases. The distance between the two bases is called height or length of the right prism.
- Lateral surface area = perimeter of base \times height
Total surface area = Lateral surface area + $2 \times$ area of base
Volume = area of base \times height

- **Cube:** A right prism whose base is a square and height is equal to the side of the base is called a cube.
Volume = a^3 where “ a ” is the side of the cube.



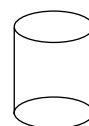
Lateral surface area = $4a^2$ and
Total surface area = $6a^2$

- **Cuboid:** A right prism whose base is a rectangle is called a rectangular solid or cuboid. If l and b are the length and breadth of the base and h , the height, then
Volume = lbh



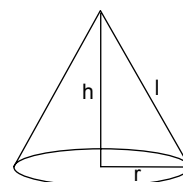
Lateral surface area = $2(l + b)h$
Total surface area = $2(l + b)h + 2lb = 2(lb + lh + bh)$
Longest diagonal of the cuboid = $\sqrt{l^2 + b^2 + h^2}$

- **Cylinder:** A cylinder can be considered as a right prism whose base is a circle. A cylinder has a single curved surface as its lateral faces. If “ r ” is the radius of the base and “ h ” is the height of the cylinder,



Volume = $\pi r^2 h$
Curved surface area = $2\pi r h$
Total surface area = $2\pi r h + 2\pi r^2 = 2\pi r(h + r)$
A hollow cylinder has a cross-section of a circular ring.
Volume of the material contained in a hollow cylindrical ring = $\pi(R^2 - r^2)h$ where R is the outer radius, r is the inner radius and h is the height.

- **Cone:** A cone is equivalent to a right pyramid whose base is a circle.
The lateral surface of a cone does not consist of triangles like in a right pyramid but is a single curved surface. Volume = $\frac{1}{3} \pi r^2 h$; where r is the radius of the base, h is height of the cone and l is the slant height.



Curved surface area = πrl ;

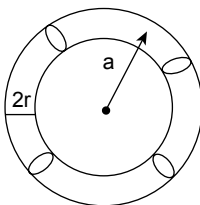
Total surface area = $\pi rl + \pi r^2 = \pi r(l + r)$

- **Sphere:** Any point on the surface of a sphere is equidistant from the centre of the sphere. This distance is the radius of the sphere.

Surface area of a sphere = $4\pi r^2$ Volume of a sphere = $(4/3)\pi r^3$

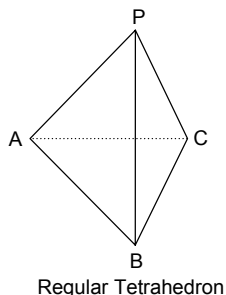
- **Torus (solid ring):** A torus is a three dimensional figure formed by the revolution of a circle about an axis lying in its plane but not intersecting the circle.

If r is the radius of circle that rotates and a is the distance of the centre of rotating circle from the axis, then surface area of torus = $4\pi^2 ra$ sq. units and Volume of torus = $2\pi^2 r^2 a$ cubic units.



Polyhedrons: A solid bounded by plane polygons is a polyhedron. The bounding polygons are known as the faces and the intersection of the faces are edges. The points where three or more edges intersect are called the vertices. A polyhedron having four faces is a **tetrahedron**, one having six faces is a hexahedron and one having eight faces is a **octahedron**.

Tetrahedron: A regular tetrahedron is a tetrahedron having all of its faces as equilateral triangles.



Vertical height of a tetrahedron of edge a unit is $\sqrt{\frac{2}{3}} a$;
slant height is $\frac{\sqrt{3}}{2} a$.

The lateral surface area of a regular tetrahedron = $1/2 \times \text{Perimeter of base} \times \text{Slant height}$

$$= 1/2 \times 3a \times \frac{\sqrt{3}}{2} a = \frac{3\sqrt{3}}{4} a^2 \text{ (where } a \text{ is the edge).}$$

The total surface area of a regular tetrahedron = L.S.A

$$+ \text{Area of base} = \frac{3\sqrt{3}}{4} a^2 + \frac{\sqrt{3}}{4} a^2 = \sqrt{3} a^2.$$

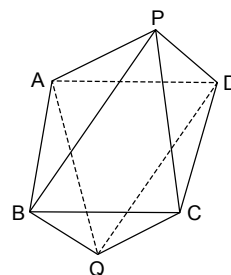
Volume of a regular tetrahedron = $1/3 \times \text{Area of base}$

$$\begin{aligned} \times \text{Vertical height} &= \frac{1}{3} \times \frac{\sqrt{3}}{4} a^2 \times \frac{\sqrt{2}}{\sqrt{3}} a \\ &= \frac{a^3}{6\sqrt{2}} \end{aligned}$$

A Regular octahedron: It is an octahedron whose faces are all congruent equilateral triangles.

The surface area of the octahedron

$$= 8 \times \frac{\sqrt{3}}{4} a^2 = 2\sqrt{3} a^2 \text{ sq units.}$$



Volume of a regular octahedron

$$= 2 \left(\frac{1}{3} \times a^2 \times \frac{a}{\sqrt{2}} \right) = \frac{\sqrt{2}}{3} a^3 \text{ cu units.}$$

Solved Examples

1. Find the area of the triangle whose sides are 6 cm, 7 cm and 11 cm.

☞ **Solution:** Area of a triangle whose sides (in cm)

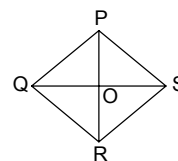
are a , b and $c = \sqrt{s(s-a)(s-b)(s-c)}$ where

$$s = \frac{a+b+c}{2} \Rightarrow s = \frac{6+7+11}{2} = 12$$

$$\text{Area} = \sqrt{12(12-6)(12-7)(12-11)} = 6\sqrt{10} \text{ cm}^2$$

2. In a rhombus PQRS, PR = 24 cm and QS = 18 cm. Find the perimeter of the rhombus.

☞ **Solution:** Let the point of intersection of the diagonals of the rhombus be denoted by the point O.



$$PO = \frac{PR}{2} = 12 \text{ cm}$$

$$QO = \frac{QS}{2} = 9 \text{ cm}$$

$$PQ = \sqrt{PO^2 + OQ^2} = \sqrt{12^2 + 9^2} \\ = \sqrt{144 + 81} = \sqrt{225} = 15 \text{ cm.}$$

$$\therefore \text{ side} = 15 \text{ cm}$$

$$\therefore \text{ Perimeter} = 4(\text{side}) = 60 \text{ cm.}$$

3. A parallelogram has a base of 18 cm and an altitude of 16 cm. Find its area.

Solution: Area of a parallelogram = Base \times Altitude
Area = $18 \times 16 = 288 \text{ cm}^2$.

4. ABCD is a square. PQRS is a square formed by joining the mid-points of AB, BC, CD and AD respectively. EFGH is a square formed by joining the mid-points of PQ, QR, RS and PS respectively. Find the sum of the perimeters of ABCD, PQRS and EFGH, if the area of square EFGH is 25 cm^2 .

Solution: Let the side of the outer square ABCD be a cm.

$$\Rightarrow \text{ Side of square PQRS} = \frac{BD}{2} = \frac{\sqrt{2}a}{2} = \frac{a}{\sqrt{2}} = PS$$

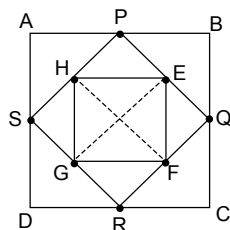
And the side of square EFGH

$$= \frac{GE}{\sqrt{2}} = \frac{PS}{\sqrt{2}} = \frac{\left(\frac{a}{\sqrt{2}}\right)}{\sqrt{2}} = \frac{a}{2} \text{ cm.}$$

$$\therefore \text{ Area of square EFGH} = \frac{a}{2} \times \frac{a}{2} = \frac{a^2}{4} \text{ cm}^2$$

$$\text{Given, } \frac{a^2}{4} = 25 \Rightarrow a^2 = 100 \Rightarrow a = 10$$

$$\therefore \text{ Perimeter of ABCD} = 4a = 40 \text{ cm}$$



$$\text{Perimeter of PQRS} = 4 \times \frac{a}{\sqrt{2}} = 20\sqrt{2} \text{ cm and perimeter of EFGH} = 20 \text{ cm}$$

$$\therefore \text{ The required perimeter} = (40 + 20\sqrt{2}) \text{ cm}$$

5. Find the perimeter of a square inscribed in a circle of radius 7 cm.

Solution: $r = 7 \text{ cm} \Rightarrow 2r = 14 \text{ cm} = a\sqrt{2}$ (a is side of square)

$$\Rightarrow a = 14/\sqrt{2} = 7\sqrt{2}. \text{ Perimeter of the square} = 4a \\ = 4 \times 7\sqrt{2} = 28\sqrt{2} \text{ cm}$$

6. Find the area of a circle whose radius is equal to the side of an equilateral triangle of area $9\sqrt{3} \text{ cm}^2$.

Solution: Area of equilateral triangle = $\sqrt{3}/4 a^2$
 $= 9\sqrt{3}$

$$\Rightarrow a = 6 \text{ cm}$$

$$\therefore \text{ Area of circle} = \pi \times 6 \times 6 = 36\pi \text{ cm}^2$$

7. If the diagonal of a square is increased by 35%, then find the percentage increase in the area of the square.

Solution: Since diagonal = $\sqrt{2}a$
If the diagonal increases by 35%, a also increases by 35%

$$a' = a + 0.35a = (1.35)a$$

$$\therefore (a')^2 = (1.35a)^2 = 1.8225 a^2$$

$$\therefore \text{ Change} = 0.8225a^2$$

$$\therefore \text{ Increase in area} = 82.25\%$$

8. A circle is inscribed in an equilateral triangle. If the inradius is 21 cm, what is the area of the triangle?

Solution: Height of the equilateral triangle = $3 \times 21 = 63 \text{ cm}$

$$\frac{\sqrt{3}}{2} \times \text{side} = 63 \text{ cm}$$

$$\Rightarrow \text{ Side} = \frac{63 \times 2}{\sqrt{3}} \text{ cm.}$$

$$\text{Area of the triangle} = \frac{\sqrt{3}}{4} \times S^2$$

$$= \frac{\sqrt{3}}{4} \times \frac{63 \times 2}{\sqrt{3}} \times \frac{63 \times 2}{\sqrt{3}} \\ = 1323\sqrt{3} \text{ sq units.}$$

9. The radius of a circle is 12 cm. If a chord of length 12 cm is drawn, then find the area of the smaller segment.

Solution: Let AB be the chord and O be the centre of the circle.

$$OA = OB = AB = 12 \text{ cm.}$$

$$\therefore \text{ OAB is an equilateral triangle and } \angle AOB = 60^\circ$$

Area of smaller segment = Area of sector AOB –
Area of triangle AOB.

$$= \frac{60}{360} \times \pi (12)^2 - \frac{\sqrt{3}}{4} (12)^2$$

$$= (24\pi - 36\sqrt{3}) \text{ sq units.}$$

10. The base of a right prism is a right angled triangle. The measure of the base of the right angled triangle is 3 m and its height 4 m. If the height of the prism is 7 m, then find (i) the number of edges of the prism (ii) the volume of the prism (iii) the total surface area of the prism.

👉 **Solution:**

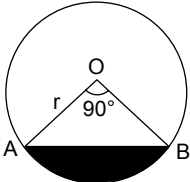
- (i) The number of the edges = The number of sides of the base $\times 3 = 3 \times 3 = 9$
 (ii) The volume of the prism = Area of the base \times
 Height of the prism = $\frac{1}{2} (3 \times 4) \times 7 = 42 \text{ m}^3$
 (iii) TSA = LSA + 2(area of base) = ph + 2(area of base) where, p = perimeter of the base = sum of lengths of the sides of the given triangle.

As, hypotenuse of the triangle = $\sqrt{3^2 + 4^2}$
 $= \sqrt{25} = 5 \text{ m}$

PRACTICE EXERCISE 4 (A)

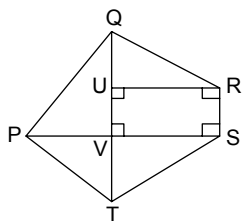
Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. If the circumference (in cm) and the area (in cm^2) of a circle are equal, then find the radius of the circle.
 - (1) 1 cm (2) 2 cm
 - (3) 3 cm (4) 4 cm
2. Find the area of an isosceles triangle, one of whose equal sides is 5 units and base 6 units in sq units.
 - (1) 10 (2) 12
 - (3) 13 (4) 15
3. An edge of a regular tetrahedron is $6\sqrt{6}$ cm. Find the vertical height of the tetrahedron (in cm).
 - (1) $6\sqrt{3}$ (2) $6\sqrt{2}$
 - (3) 12 (4) 24
4. Find the area of a quadrilateral which has one of its diagonals as 10 cm and the lengths of the offsets drawn to it are 3 cm and 5 cm (in cm^2).
 - (1) 25 (2) 36
 - (3) 40 (4) 32
5. Find the area of a triangle whose sides are 15 cm, 8 cm and 17 cm.
 - (1) 120 cm^2 (2) 68 cm^2
 - (3) 136 cm^2 (4) 60 cm^2
6. The area of an equilateral triangle is $25\sqrt{3} \text{ cm}^2$. Find the side of the triangle (in cm).
 - (1) 10 (2) $5\sqrt{3}$
 - (3) 5 (4) $10\sqrt{3}$
7. A triangle has a perimeter of 9 cm. How many combinations of its sides exist, if their lengths in cm are integers?
 - (1) 1 (2) 2
 - (3) 3 (4) 4
8. Three equilateral triangles are cut from an equilateral triangle of area 36 cm^2 , such that a regular hexagon is left. Find the area of hexagon (in cm^2)
 - (1) 24 (2) 28
 - (3) 30 (4) 32
9. In a circle of radius 7 cm, arc AB makes one angle 90° at the centre O. Find the length of the major arc AB.
 - (1) 28 cm (2) 31 cm
 - (3) 33 cm (4) 35 cm
10. A right triangle has a perimeter of 48 cm and an area of 96 cm^2 . Find its hypotenuse (in cm).
 - (1) 18 (2) 20
 - (3) 24 (4) 27
11. A rhombus has the sum of its diagonals equal to 34 cm. Its longer diagonal is 14 cm longer than its shorter diagonal. Find its area (in cm^2).
 - (1) 100 (2) 120
 - (3) 135 (4) 150
12. The sum of the products of the sides of a triangle (in cm) taken two at a time is K. The square of its perimeter (in cm) is $3K$. If its sides (in cm) are integers, then which of the following cannot be its perimeter (in cm)?
 - (1) 9 (2) 12
 - (3) 15 (4) 16
13. A trapezium is inscribed in a circle. Its longer parallel side is 10 cm. The sum of the lengths its parallel sides and that of its non-parallel sides are in the ratio 1 : 1. If each side has an integral measure (in cm), then find its maximum possible perimeter (in cm).
 - (1) 42 (2) 30
 - (3) 36 (4) 39
14. Find the perimeter of a circle whose radius is 7 cm (in cm).
 - (1) 12π (2) 14π
 - (3) 16π (4) 10π
15. Find the area of a circle, whose radius is 7 cm (in cm).
 - (1) 42π (2) 49π
 - (3) 54π (4) 60π
16. Area of the shaded part in the given figure is ____ (where O is the centre of the circle).



 - (1) $\left(\frac{\pi-2}{4}\right)r^2$ (2) $\left(\frac{2-\pi}{4}\right)r^2$
 - (3) $\left(\frac{\pi-1}{2}\right)r^2$ (4) $\left(\frac{\pi-2}{2}\right)r^2$

17. The width of a circular ring is equal to the radius of the inner circle of the ring. If the radii of the inner and outer circles are r and R , then the area of the circular ring is ____.
- (1) $2\pi R^2$ (2) $2\pi r^2$
(3) $3\pi R^2$ (4) $3\pi r^2$
18. The perimeter of a scalene triangle, an isosceles triangle and an equilateral triangle are equal. Which triangle can have more area?
- (1) Equilateral (2) Isosceles
(3) Scalene (4) Can't say
19. Find the area of a square inscribed in a circle of radius $5\sqrt{2}$ cm. (in cm^2)
- (1) 75 (2) 100
(3) 125 (4) 150
20. In the given figure (not to scale), $QT = 90$ m and $UR = 50$ m. $QU : UT = UV : VT = 1 : 2$. $PV : VS = 4 : 5$. Find the area of the figure (in m^2).



- (1) 4250 (2) 3980
(3) 4380 (4) 4550
21. H_1 is a regular hexagon circumscribing a circle. H_2 is a regular hexagon inscribed in the circle. Find the ratio of areas of H_1 and H_2 .
- (1) 3:2 (2) 4:3
(3) 2:1 (4) 5:4
22. The heights of two cylinders are equal and their radii are in the ratio of 3: 2, then the ratio of their curved surface areas is ____.
- (1) 3: 2 (2) 2: 1
(3) 3: 1 (4) 4: 3
23. The TSA of a cube in cm^2 is equal to the volume of the cube in cm^3 . The edge of the cube is _____. (in cm)
- (1) 3 (2) 4
(3) 5 (4) 6
24. The length of the shortest face diagonal of a cuboid of dimensions $5 \text{ cm} \times 4 \text{ cm} \times 3 \text{ cm}$ is _____. (in cm)

- (1) 4 (2) 5
(3) 6 (4) 7
25. If the edge of a cube increases by 10%, then find the percentage increase in its volume.
(1) 20% (2) 30%
(3) $66.\overline{6}\%$ (4) 33.1%
26. Three cubes of sides 3 cm, 4 cm and 5 cm respectively are melted and recasted into a larger cube. What is the side of the cube so formed?
(1) 12 cm (2) 9 cm
(3) 8 cm (4) 6 cm
27. The cost of the canvas required to make a conical tent of base radius 8 m at the rate of ₹40 per m^2 is ₹10048. Find the height of the tent. (Take $\pi = 3.14$)
(1) 6 m (2) 7 m
(3) 8 m (4) 10 m
28. A dish, in the shape of a frustum of a cone, has a height of 6 cm. Its top and its bottom have radii of 24 cm and 16 cm respectively. Find its curved surface area (in cm^2).
(1) 200π (2) 300π
(3) 400π (4) 500π
29. A model of a building is in the form of a cone surmounting a cylinder. The radius of the cylinder is 6 cm. The height of the model is $6\sqrt{3}$ cm. The vertical angle of the cone is 120° . Find the volume of the model. (in cm^3)
(1) $148\sqrt{3}\pi$ (2) $156\sqrt{3}\pi$
(3) $162\sqrt{3}\pi$ (4) $168\sqrt{3}\pi$
30. If the dimensions of a cuboid are $5\text{ cm} \times 4\text{ cm} \times 3\text{ cm}$, then find the maximum volume of the cube that can be carved out of it. (in cm^3)
(1) 24 (2) 27
(3) 30 (4) 33
31. The sides of a bases of a pentagonal prism are 4 cm, 5 cm, 7 cm, 9 cm and 10 cm. Its height is 6 cm. Find the total length of its edges (in cm).
(1) 100 (2) 90
(3) 110 (4) 120
32. Find the number of cubes of side 20 cm to be dropped in a cylindrical vessel of radius 140 cm to increase the water level by 5 m.
(1) 275 (2) 325
(3) 360 (4) 385

33. A cuboidal container has dimensions of $20 \text{ cm} \times 18 \text{ cm} \times 16 \text{ cm}$. Find the maximum number of syrup bottles whose contents can be emptied into the container if each bottle contains 24 cm^3 of syrup.

(1) 120 (2) 180
(3) 240 (4) 270

34. Solid cylinders of equal volume are tightly packed in two layers in a rectangular box, such that in each layer there are three rows of four such cylinders. Find the percentage of volume of empty space in the box approximately.

(1) 19.27% (3) 20.54%
(3) 21.43% (4) 22.36%

35. Three solid cubes have a face diagonal of $4\sqrt{2} \text{ cm}$ each. Three other solid cubes have a face diagonal of $8\sqrt{2} \text{ cm}$ each. All the cubes are melted together to form a big cube. Find the side of the cube formed. (in cm)

(1) 10 (2) 12
(3) 13 (4) 15

36. A square sheet of side 28 cm is folded into a cylinder by joining its two sides. Find the base area of the cylinder thus formed. (in cm^2)

(1) $\frac{524}{11}$ (2) $\frac{575}{11}$
(3) $\frac{629}{11}$ (4) $\frac{686}{11}$

37. A rectangular sheet of dimensions $7 \text{ cm} \times 6 \text{ cm}$ was folded along its breadth to form cylinder such that the perimeter of base of the cylinder is equal to the breadth of the sheet. Find the approximate volume (in cm^3) of the enclosed space.

(1) 20 (2) 22
(3) 25 (4) 30

38. A largest possible cuboid is carved out of a wooden cylinder. The cylinder has a base radius of $14\sqrt{2} \text{ cm}$ and a height of 16 cm . Find the volume of wood wasted. (in cm^3) (Take $\pi = \frac{22}{7}$)

(1) 6524 (2) 6838
(3) 7168 (4) 7456

Directions for questions 39 and 40: Match the Column A with Column B.

39.

Column A

Column B

- (a) Volume of a prism whose each lateral face is a square of side r and base is an equilateral triangle () (p) $3\sqrt{3}r^3$
(b) Volume of a cuboid whose base is a square of side r and each lateral face is rectangle of length $2r$ () (q) $\frac{3r^3}{2}$
(c) Volume of a cylinder whose base radius is r and height being $\frac{21}{44}$ times the radius () (r) $2r^3$
(d) Volume of a regular hexagonal prism of side r and height being $2r$ () (s) $\frac{\sqrt{3}}{4}r^3$

(1) pqrs
(2) srp q
(3) srqp
(4) prgq

40.

Column A

Column B

- (a) Number of edges of a pyramid whose base is a pentagon () (p) 12
(b) Number of vertices of a pyramid whose base is hexagon () (q) 10
(c) Volume of a cone whose base radius is 3 units and height is $\frac{7}{22}$ units (in cubic units) () (r) 3
(d) Total length of the edges of a pyramid whose base and lateral faces are equilateral triangles of side 2 units (in units) () (s) 7

(1) qspr (2) qsrp
(3) qpsr (4) rpsq

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

- Which of the following is formed by joining the mid-points of the adjacent sides of a quadrilateral?
 (1) square (2) rectangle
 (3) rhombus (4) parallelogram
- The diagonal of a square is 10 cm. Its area is _____. (in cm^2)
 (1) 25 (2) 50
 (3) 75 (4) 100
- If $p + q$ and $p - q$ are the sides of a rectangle, then its diagonal is equal to _____ units.
 (1) $\sqrt{2(p^2 - q^2)}$ (2) $\sqrt{2(p^2 + q^2)}$
 (3) $2\sqrt{p^2 - q^2}$ (4) $2\sqrt{p^2 + q^2}$
- The diagonal of a rectangle whose length is 20 cm and breadth is 15 cm, is _____.
 (1) 35 cm (2) 30 cm
 (3) 25 cm (4) 40 cm
- If the perimeter of a circle is P cm, then find the length of an arc of the circle which subtends 144° at the centre of the circle (in cm).
 (1) $2P/5$ (2) $3P/5$
 (3) $P/5$ (4) $4P/5$
- If the area of a square is 32 cm^2 , then find the diagonal of the square.
 (1) 8 cm (2) $4\sqrt{2}$ cm
 (3) $8\sqrt{2}$ cm (4) 4 cm
- In a $\triangle ABC$, $\overline{AD} \perp \overline{BC}$ and $\overline{CF} \perp \overline{AB}$, $AB = 6.4$ cm, $CF = 2.6$ cm, $AD = 3.2$ cm. Find the (in cm) length of the side BC . (in cm)
 (1) 4.8 (2) 5.2
 (3) 5.6 (4) 6.2
- Find the area of the circle, if the area of an isosceles right triangle inscribed in it is 18 cm^2 .
 (1) 16π (2) 21π
 (3) 18π (4) 24π
- In a triangle, half of each side is less than the average of the other two sides by 4 cm. Find its area (in cm^2).
 (1) $16\sqrt{3}$ (2) $18\sqrt{3}$
 (3) $15\sqrt{3}$ (4) $20\sqrt{3}$
- A regular hexagon is inscribed in a circle of radius 6 cm. Find its area (in cm^2).
 (1) $48\sqrt{3}$ (2) $54\sqrt{3}$
 (3) $48\sqrt{2}$ (4) $54\sqrt{2}$
- A circle of radius 4 cm is inscribed in an equilateral triangle T . Find the area of T (in cm^2).
 (1) $42\sqrt{3}$ (2) $45\sqrt{3}$
 (3) $48\sqrt{3}$ (4) $50\sqrt{3}$
- R is a rectangle. If its length and breadth are both increased by y cm, its area would increase by 32 cm^2 . If its length and breadth are both decreased by y cm, its area would decrease by 24 cm^2 . Find y .
 (1) 1 (2) 2
 (3) 3 (4) 4
- The height of an equilateral triangle, whose side is 6 cm, is _____. (in cm)
 (1) $2\sqrt{3}$ (2) $4\sqrt{3}$
 (3) $6\sqrt{3}$ (4) $3\sqrt{3}$
- The circumradius of an equilateral triangle, whose side is 6 cm, is _____. (in cm)
 (1) $2\sqrt{3}$ (2) $3\sqrt{3}$
 (3) $4\sqrt{3}$ (4) $5\sqrt{3}$
- The circumradius of an equilateral triangle is x cm. The area of the triangle in terms of x is _____. (in cm^2)
 (1) $\frac{3\sqrt{3}}{2}x^2$ (2) $\frac{3\sqrt{3}}{4}x^2$
 (3) $\frac{4\sqrt{3}}{5}x^2$ (4) $\frac{5\sqrt{3}}{4}x^2$
- If one of the perpendicular sides of a right isosceles triangle is $2R$, then the circumradius of the triangle is _____.
 (1) R (2) $\frac{R}{2}$
 (3) $\sqrt{2}R$ (4) $\frac{R}{\sqrt{2}}$
- A regular hexagon is inscribed in a circle of radius r . By how much is the area of the circle more than the area of the hexagon?

- (1) $(\pi - 2\sqrt{3})r^2$ (2) $(\pi - \sqrt{3})r^2$
 (3) $\left(\pi - \frac{\sqrt{3}}{2}\right)r^2$ (4) $\left(\pi - \frac{3\sqrt{3}}{2}\right)r^2$

18. From a circle of radius 7 cm, the largest possible square is cut and removed. Find the area of the remaining portion. (in cm^2)

- (1) 48 (2) 50
 (3) 54 (4) 56

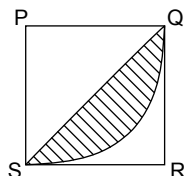
19. An equilateral triangle circumscribes a circle of circumference 16π cm. Find its perimeter. (in cm)

- (1) $32\sqrt{3}$ (2) $48\sqrt{3}$
 (3) $64\sqrt{3}$ (4) $80\sqrt{3}$

20. Two circles touch each other externally. The sum of their areas is $490\pi \text{ cm}^2$. Their centers are separated by 28 cm. Find the difference of their radii. (in cm)

- (1) 7 (2) 14
 (3) 21 (4) 18

21. In the given figure, PQRS is a square of diagonal $7\sqrt{2}$ cm. With P as the centre, the arc QS is drawn. Find the area of the shaded region. (in cm^2)



- (1) $\frac{49}{4}(\pi - 2)$ (2) $\frac{47}{4}(\pi - 2)$
 (3) $\frac{49}{4}(\pi - 3)$ (4) $\frac{47}{4}(\pi - 3)$

22. The longest needle that can be placed in a cylinder of radius r units and height h units is _____. (in units)

- (1) $\sqrt{4r^2 + h^2}$ (2) $\sqrt{3r^2 + h^2}$
 (3) $\sqrt{4r^2 - h^2}$ (4) $\sqrt{3r^2 + 2h^2}$

23. The number of edges of a pentagonal prism is ____.

- (1) 12 (2) 15
 (3) 18 (4) 21

24. If the largest diagonal of a cube is 6 cm, then the edge of the cube is _____ cm.

- (1) $3\sqrt{2}$ (2) $2\sqrt{3}$
 (3) $3\sqrt{3}$ (4) $2\sqrt{2}$

25. What is the volume (in cm^3) of the prism whose base is a hexagon of side 6 cm and height $12\sqrt{3}$ cm?

- (1) $1944\sqrt{3}$ (2) 1944
 (3) $1654\sqrt{3}$ (4) 1654

26. If f , e and v represent the number of rectangular faces, number of edges and number of vertices respectively of a cuboid, then the value of $f + e + v$ is ____.

- (1) 20 (2) 26
 (3) 30 (4) 18

27. Volumes of two cylinders of radii R , $R/2$ and heights H , h respectively are equal. Then $H : h =$ ____.

- (1) 1 : 2 (2) 1 : 4
 (3) 2 : 1 (4) 4 : 1

28. If eight cubes are stacked to form a big cube, then find the percentage decrease in the total surface area.

- (1) 30% (2) 40%
 (3) 50% (4) 60%

29. A square plate of side 44 cm is made into a cylinder by joining two edges of it. Find the base area of the cylinder formed. (in cm^2)

- (1) 77 (2) 154
 (3) 38.5 (4) 308

30. The diagonal of a square is equal to the edge of a cube. The longest diagonal of the cube is $6\sqrt{6}$ cm. Find the side of the square (in cm).

- (1) 6 (2) 7
 (3) 8 (4) 9

31. If the radius of a cylinder increases by y cm, its volume becomes $V \text{ cm}^3$. If its height increased by $4y$ cm, its volume would become $V \text{ cm}^3$. If its radius as well as its height equals 6 cm, then find y .

- (1) 10 (2) 12
 (3) 14 (4) 16

32. Three cubes each of side 3.2 cm are joined end to end. Find the total surface area of the resulting cuboid. (in cm^2)

- (1) 124.51 (2) 136.15
 (3) 143.36 (4) 148.27

33. A metallic cuboid of dimensions $36 \text{ cm} \times 18 \text{ cm} \times 11 \text{ cm}$ is melted to form lead balls each of diameter 3 cm. Find the number of such lead balls formed.

- (1) 476 (2) 504
 (3) 448 (4) 532

34. A rectangular sump has an inner length and breadth of 24 m and 20 m respectively. Water flows through an inlet pipe at 180 m per minute. The cross-sectional area of the pipe is 0.5 sq m. The tank takes half an hour to get filled. Find the depth of the sump. (in m)

(1) 4.75 (2) 4.825
(3) 5.625 (4) 5.78

35. Find the number of cubes of side 2 cm to be dropped in a cylindrical vessel of radius 14 cm in order to increase the water level by 5 cm.

(1) 270 (2) 325
(3) 385 (4) 420

36. A cylindrical trunk of a tree has a girth (circumference) of 880 cm and a height of 2 m. If the wood was sold at ₹100 per cu ft and wastage was 20%, then find the total amount received. (in ₹)

(1) 34811 (2) 37624
(3) 32185 (4) 39615

37. The base of a right pyramid is an equilateral triangle, each side of which is $6\sqrt{3}$ cm long and its height is 4 cm. Find the total surface area of the pyramid in cm^2 .

(1) $64\sqrt{3}$ (2) $68\sqrt{3}$
(3) $72\sqrt{3}$ (4) $76\sqrt{3}$

38. A sector of a circle of radius 10 cm is folded such that it forms into a cone. If the central angle of the sector is 144° , then what is the volume of the cone formed? (in cm^3)

(1) $\frac{704\sqrt{2}}{21}$ (2) $\frac{628\sqrt{11}}{11}$
(3) $\frac{576\sqrt{21}}{21}$ (4) $\frac{682\sqrt{11}}{11}$

39. A drum is in the shape of a frustum of a cone. Its top and bottom radii are 20 ft and 10 ft respectively. Its height is 15 ft. It is fully filled with water. This water is emptied into a rectangular tank. The base of the tank has the dimensions $100 \text{ ft} \times 50 \text{ ft}$. Find the rise in the height of the water level in the tank.

(1) 1.9 ft
(2) 2.1 ft
(3) 2.2 ft
(4) 2.4 ft

Directions for question 40: Match the Column A with Column B.

40.

Column A

Column B

- | | |
|---|---------------------------|
| (a) Volume of a solid hemisphere of radius r | (p) $\frac{28\pi r^3}{3}$ |
| (b) Volume of hemispherical shell whose thickness is equal to inner radius r | (q) $\frac{14\pi r^3}{3}$ |
| (c) Volume of a hollow sphere whose thickness is equal to the inner radius r | (r) $\frac{2\pi r^3}{3}$ |
| (d) Volume of a top which is in the form of a cone surmounted by a hemisphere and the height of the conical part is equal to the radius of the hemisphere r | (s) πr^3 |

(1) pqrs
(2) rqsp
(3) rqsp
(4) rqp s

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

1. 2	2. 2	3. 3	4. 3	5. 4	6. 1	7. 3	8. 1	9. 3	10. 2
11. 2	12. 4	13. 3	14. 2	15. 2	16. 1	17. 4	18. 1	19. 2	20. 4
21. 2	22. 1	23. 4	24. 2	25. 4	26. 4	27. 1	28. 3	29. 4	30. 2
31. 1	32. 4	33. 3	34. 3	35. 2	36. 4	37. 1	38. 3	39. 3	40. 2

PRACTICE EXERCISE 4 (B)

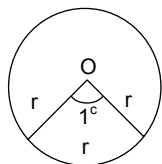
1. 4	2. 2	3. 2	4. 3	5. 1	6. 1	7. 2	8. 3	9. 1	10. 2
11. 3	12. 2	13. 4	14. 1	15. 2	16. 3	17. 4	18. 4	19. 2	20. 2
21. 1	22. 1	23. 2	24. 2	25. 2	26. 2	27. 2	28. 3	29. 2	30. 1
31. 2	32. 3	33. 2	34. 3	35. 3	36. 1	37. 3	38. 1	39. 3	40. 4

Trigonometry

SYNOPSIS

Systems of Measurement of Angle

- (i) **Sexagesimal system:** In this system, the angle is measured in degrees($^{\circ}$).
1 revolution = $360^{\circ} \Rightarrow$ 1 right angle = 90°
 $1^{\circ} = 60'$ (minutes) and $1' = 60''$ (seconds)
- (ii) **Centesimal system:** In this system, the angle is measured in grades.
1 revolution = 400 grades \Rightarrow 1 right angle = 100^g
 $1^g = 100'$ (minutes) and $1' = 100''$ (seconds)
- (iii) **Circular system:** In this system, the angle is measured in radians. The angle subtended by an arc of length equal to the radius of a circle at its centre is said to have a measure of one radian. It is written as 1^c .
 \therefore 1 revolution = $2\pi^c$



Relation between the Units of the Three Systems

When a rotating ray completes one revolution, the measure of angle formed about the vertex is 360° or 400^g or $2\pi^c$ so,

$$360^{\circ} = 400^g = 2\pi^c \text{ (or) } 90^{\circ} \\ = 100^g = \frac{\pi^c}{2}$$

Note:

- (i) $1^{\circ} = \frac{\pi}{180}$ radians = 0.0175 radians (approx)
- (ii) $1^c = \frac{180}{\pi}$ degrees = $57^{\circ}17'44''$ (approx)

Relation between the Ratios

- (i) $\operatorname{cosec}\theta = \frac{1}{\sin\theta}$, $\sec\theta = \frac{1}{\cos\theta}$ and $\cot\theta = \frac{1}{\tan\theta}$
- (ii) $\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $\cot\theta = \frac{1}{\tan\theta} = \frac{\cos\theta}{\sin\theta}$

Values of Trigonometric Ratios for Specific Angles

θ	0°	30°	45°	60°	90°
Ratio					
$\sin\theta$	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
$\cos\theta$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0
$\tan\theta$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	∞
$\operatorname{cosec}\theta$	∞	2	$\sqrt{2}$	$2/\sqrt{3}$	1
$\sec\theta$	1	$2/\sqrt{3}$	$\sqrt{2}$	2	∞
$\cot\theta$	∞	$\sqrt{3}$	1	$1/\sqrt{3}$	0

From the above table, we observe that

- (i) $\sin\theta = \cos\theta$, $\tan\theta = \cot\theta$ and $\sec\theta = \operatorname{cosec}\theta$ if $\theta = 45^\circ$
- (ii) $\sin\theta$ and $\tan\theta$ are increasing functions when $0^\circ \leq \theta \leq 90^\circ$
- (iii) $\cos\theta$ is a decreasing function when $0^\circ \leq \theta \leq 90^\circ$.

Trigonometric Ratios of Compound Angles

- (i) $\sin(A + B) = \sin A \cos B + \cos A \sin B$ and $\sin(A - B) = \sin A \cos B - \cos A \sin B$.
- (ii) $\cos(A + B) = \cos A \cos B - \sin A \sin B$ and $\cos(A - B) = \cos A \cos B + \sin A \sin B$.
- (iii) $\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$ and $\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$

Also, by taking $A = B$ in the above relations, we get,

- (i) $\sin 2A = 2 \sin A \cos A$
- (ii) $\cos 2A = \cos^2 A - \sin^2 A = 2 \cos^2 A - 1 = 1 - 2 \sin^2 A$.
- (iii) $\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$

Signs of Trigonometric Ratios

- (i) If θ lies in the first quadrant, i.e., $0 < \theta < \pi/2$, then all the trigonometric ratios are taken positive.
- (ii) If θ lies in the second quadrant, i.e., $\pi/2 < \theta < \pi$, then only $\sin\theta$ and $\operatorname{cosec}\theta$ are taken positive and all the other trigonometric ratios are taken negative.
- (iii) If θ lies in the third quadrant, i.e., $\pi < \theta < \frac{3\pi}{2}$, then only $\tan\theta$ and $\cot\theta$ are taken positive and all the other trigonometric ratios are taken negative.

- (iv) If θ lies in the fourth quadrant, i.e., $\frac{3\pi}{2} < \theta < 2\pi$, then only $\cos\theta$ and $\sec\theta$ are taken positive and all the other trigonometric ratios are taken negative.

Heights and Distances

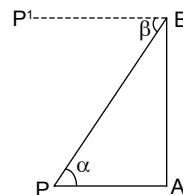
Let AB be a vertical line and PA and P'B be two horizontal lines as shown in the figure.

Let $\angle APB = \alpha$ and $\angle PBP' = \beta$.

Then,

α is called the angle of elevation of the point B as seen from the point P and

β is called the angle of depression of the point P as seen from the point B.



Note: Angle of elevation is always equal to the angle of depression.

Important notes:

- (i) $\sin^2\theta + \cos^2\theta = 1$
- (ii) $\sec^2\theta - \tan^2\theta = 1$
- (iii) $\operatorname{cosec}^2\theta - \cot^2\theta = 1$
- (iv) $\sin(-\theta) = -\sin\theta$, $\cos(-\theta) = \cos\theta$ and $\tan(-\theta) = -\tan\theta$
- (v) Maximum value of $a \sin\theta + b \cos\theta = \sqrt{a^2 + b^2}$
Minimum value of $a \sin\theta + b \cos\theta = -\sqrt{a^2 + b^2}$

Solved Examples

- What is the sexagesimal measure of angle measuring $\frac{\pi^c}{3}$ and 300° ?

☞ **Solution:** $\therefore \frac{\pi^c}{3} = \frac{180^\circ}{3} = 60^\circ$

$$300^\circ = \frac{9}{10} \times 360 = 270^\circ$$

Hence, the sexagesimal measure of $\frac{\pi^c}{3}$ is 60° and 300° is 270° .

- Find the value of $\sin 75^\circ$.

☞ **Solution:** We have, $\sin 75^\circ = \sin(45^\circ + 30^\circ)$

$$= \sin 45^\circ \cos 30^\circ + \cos 45^\circ \sin 30^\circ$$

$$= \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \cdot \frac{1}{2} = \frac{\sqrt{3} + 1}{2\sqrt{2}}$$

$$\therefore \sin 75^\circ = \frac{\sqrt{3} + 1}{2\sqrt{2}}$$

3. Find the relation obtained by eliminating θ from the equations $x = r \cos \theta + s \sin \theta$ and $y = r \sin \theta - s \cos \theta$.

☞ **Solution:** Given, $x = r \cos \theta + s \sin \theta$
 $\Rightarrow x^2 = (r \cos \theta + s \sin \theta)^2 = r^2 \cos^2 \theta + 2rs \cos \theta \sin \theta + s^2 \sin^2 \theta$

Also $y = r \sin \theta - s \cos \theta \Rightarrow y^2 = r^2 \sin^2 \theta + s^2 \cos^2 \theta - 2rs \sin \theta \cos \theta$

$$\Rightarrow x^2 + y^2 = r^2 (\cos^2 \theta + \sin^2 \theta) + s^2 (\sin^2 \theta + \cos^2 \theta)$$

$$= r^2 (1) + s^2 (1) [\because \sin^2 \theta + \cos^2 \theta = 1] = r^2 + s^2$$

Hence, the required relation is $x^2 + y^2 = r^2 + s^2$

4. If $\cos(A + B) = 1/2$ and $\sec B = \sqrt{2}$, then find A and B.

☞ **Solution:** Given, $\cos(A + B) = 1/2$
 $\cos(A + B) = \cos 60^\circ \Rightarrow A + B = 60^\circ \rightarrow (1)$
 $\sec B = \sqrt{2} = \sec 45^\circ \Rightarrow B = 45^\circ \rightarrow (2)$
 From (1) & (2), we have $A = 15^\circ$ and $B = 45^\circ$

5. If ABCD is a cyclic quadrilateral, then find the value of $\cos A \cos B - \cos C \cos D$.

☞ **Solution:** Given, ABCD is a cyclic quadrilateral
 $A + C = 180^\circ$ and $B + D = 180^\circ$ (1)
 $-\cos C \cos D = \cos A \cos B - \cos(180^\circ - A)$
 $\qquad \qquad \qquad \cos(180^\circ - B)$
 $\qquad \qquad \qquad = \cos A - \cos B - \cos A (-\cos A) (-\cos B)$
 $\qquad \qquad \qquad = \cos A \cos B - \cos A \cos B = 0$

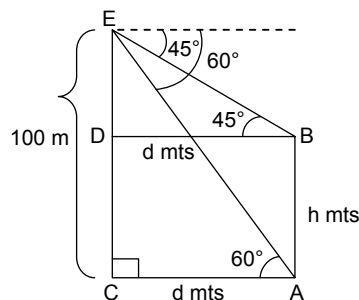
6. Express $\sqrt{3} \cos \theta - \sin \theta$ as a single trigonometric ratio.

☞ **Solution:** $\sqrt{3} \cos \theta - \sin \theta = 2 \left(\frac{\sqrt{3}}{2} \cos \theta - \frac{1}{2} \sin \theta \right)$
 $= 2 (\cos \theta \cos 30^\circ - \sin \theta \sin 30^\circ) = 2 (\cos(\theta + 30^\circ))$
 $\Rightarrow \sqrt{3} \cos \theta - \sin \theta = 2 \cos(\theta + 30^\circ)$

7. Simplify the following expression. $\sin 1^\circ \cdot \sin 2^\circ \cdots \sin 181^\circ$

☞ **Solution:** We know that, $\sin 180^\circ = 0$
 $\sin 1^\circ \cdot \sin 2^\circ \cdot \sin 3^\circ \cdots \sin 181^\circ = \sin 1^\circ \cdot \sin 2^\circ \cdots \sin 180^\circ \cdot \sin 181^\circ = 0$

8. From the top of a building 100 m high, the angles of depression of the bottom and the top of another building just opposite to it are observed to be 60° and 45° respectively. Find the height of the building.



☞ **Solution:** Let the height of the building be h metres. Let $AC = BD = d$ metres

From $\triangle BDE$, $\tan 45^\circ = \frac{ED}{BD}$

$$\Rightarrow 1 = \frac{100 - h}{d}$$

$$\Rightarrow d = 100 - h \quad \dots (1)$$

From $\triangle ACE$, $\tan 60^\circ = \frac{CE}{AC}$

$$\Rightarrow \sqrt{3} = \frac{100}{d} \Rightarrow \sqrt{3} d = 100$$

$$\Rightarrow \sqrt{3} (100 - h) = 100 \text{ (using (1))}$$

Hence, the height of the tower is, $h = \frac{100(3 - \sqrt{3})}{3} \text{ m.}$

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 45: Select the correct alternative from the given choices.

1. The value of 144° in circular measure, is ____.

(1) $\frac{3\pi^c}{4}$	(2) $\frac{2\pi^c}{3}$
(3) $\frac{4\pi^c}{5}$	(4) $\frac{5\pi^c}{6}$

2. The value of 60° in circular measure, is ____.

(1) $\frac{\pi^c}{10}$	(2) $\frac{3\pi^c}{10}$
(3) $\frac{2\pi^c}{5}$	(4) $\frac{\pi^c}{2}$

3. The value of 60° in centesimal system, is ____.

(1) $\frac{100^g}{3}$	(2) $\frac{200^g}{3}$
(3) $\frac{140^g}{3}$	(4) $\frac{160^g}{3}$

4. The angle measuring $\frac{\pi^c}{4}$ when expressed in centesimal system, is ____.

(1) 50^g	(2) 60^g
(3) 75^g	(4) 100^g

5. The value of $\frac{7\pi^c}{9}$ in sexagesimal measure is ____.

(1) 120°	(2) 130°
(3) 140°	(4) 150°

6. A wheel makes 240 revolutions in one minute. The measure of the angle it describes at the centre in 15 seconds is ____.

(1) $60\pi^c$	(2) $120\pi^c$
(3) $8\pi^c$	(4) π^c

7. If $\tan(89^\circ 16') = x$, then $\tan(269^\circ 16') =$ ____.

(1) $x/2$	(2) $x/3$
(3) x	(4) $2x$

8. The value of 45° in centesimal system, is ____.

(1) 25^g	(2) 50^g
(3) 75^g	(4) 100^g

9. $\frac{\sin 36^\circ}{\cos 54^\circ} =$ ____.

(1) 0	(2) 1
(3) $\frac{2}{3}$	(4) $\frac{3}{2}$

10. $\sec^4\theta - \sec^2\theta$ in terms of $\tan\theta$ is ____.

(1) $\tan^4\theta - \tan^2\theta$	(2) $\tan^4\theta + \tan^2\theta$
(3) $\tan^2\theta - \tan^4\theta$	(4) None of these

11. If $A + B = 60^\circ$, then the value of $\sin A \cos B + \cos A \sin B$ is ____.

(1) $\frac{1}{2}$	(2) $\frac{1}{\sqrt{2}}$
(3) $\frac{\sqrt{3}}{2}$	(4) 1

12. The value of $\sin 30^\circ \cdot \sin 45^\circ \cdot \operatorname{cosec} 45^\circ \cdot \cos 30^\circ$ is ____.

(1) $\sqrt{3}$	(2) $\frac{1}{\sqrt{3}}$
(3) $\frac{\sqrt{3}}{2}$	(4) $\frac{\sqrt{3}}{4}$

13. If $\tan\theta = \frac{5}{6}$ and $\tan\phi = \frac{1}{11}$, then $\theta + \phi =$ ____.

(1) 30°	(2) 45°
(3) 60°	(4) 90°

14. If $\operatorname{cosec}\theta - \cot\theta = x$, then $\operatorname{cosec}\theta + \cot\theta =$ ____.

(1) x	(2) $2x$
(3) $1/x$	(4) $1/2x$

15. The value of $(\sin A - \cos A)^2 + (\sin A + \cos A)^2$ is ____.

(1) 1	(2) 3
(3) 2	(4) 4

16. If $\sin A = \frac{\sqrt{3}}{2}$ and A is an acute angle, then find the value of $\frac{\tan A - \cot A}{\sqrt{3} + \operatorname{cosec} A}$.

(1) $-\frac{2}{5}$	(2) $\frac{2}{5}$
(3) $\frac{2}{3+2\sqrt{3}}$	(4) -2

17. The simplified value of

$\operatorname{cosec}^2\alpha \left(1 + \frac{1}{\sec\alpha}\right) \left(1 - \frac{1}{\sec\alpha}\right)$ is ____.

(1) 1	(2) 0
(3) 2	(4) -1

18. If $\cos\alpha = \frac{12}{13}$ and $\sin\beta = \frac{4}{5}$, then find $\sin(\alpha + \beta)$.

- (1) $\frac{63}{65}$ (2) $\frac{58}{65}$
(3) $\frac{47}{65}$ (4) $\frac{39}{65}$

19. Eliminate θ from the equations, $x = 2 \cos\theta$ and $y = -2 \sin\theta$.

- (1) $x^2 - y^2 = 4$ (2) $x^2 - y^2 = 2$
(3) $x^2 + y^2 = 4$ (4) $x^2 + y^2 = 2$

20. If $3\cos^2 A = \cos 60^\circ + \sin^2 45^\circ$, then find the value of $\sec^2 A$.

- (1) 1 (2) 0
(3) 2 (4) 3

21. If $\frac{1 + \tan\theta}{1 - \tan\theta} = \sqrt{3}$, then find the value of θ .

- (1) 15° (2) 30°
(3) 45° (4) 60°

22. Find the value of $\sin 18^\circ \operatorname{cosec} 54^\circ \operatorname{cosec} 36^\circ \sec 72^\circ \cos 54^\circ \cos 36^\circ$.

- (1) 1 (2) 0
(3) 2 (4) -1

23. Find the relation obtained by eliminating θ from the equation $x = a \cos\theta + b \sin\theta$ and $y = a \sin\theta - b \cos\theta$.

- (1) $x^2 + y^2 = a^2 - b^2$
(2) $x^2 - y^2 = a^2 + b^2$
(3) $x^2 - y^2 = a^2 - b^2$
(4) $x^2 + y^2 = a^2 + b^2$

24. The simplified value of

$$\left(\frac{1 - \sin\alpha}{\cos\alpha} + \frac{\cos\alpha}{1 + \sin\alpha} \right) \left(\sec\alpha + \frac{1}{\cot\alpha} \right) \text{ is } \underline{\hspace{2cm}}.$$

- (1) 0 (2) 1
(3) 2 (4) 3

25. If $\operatorname{cosec}\theta - \cot\theta = 2$, then find the value of $\operatorname{cosec}^2\theta + \cot^2\theta$.

- (1) $\frac{8}{15}$ (2) $\frac{15}{8}$
(3) $\frac{8}{17}$ (4) $\frac{17}{8}$

26. Solve for θ : $\frac{\cos^2\theta}{1 - \sin\theta} - \frac{3}{2} = 0$

- (1) 30° (2) 45°
(3) 60° (4) 90°

27. If $25\sin^2\theta + 10\cos^2\theta = 15$, then find $\cot^2\theta$.

- (1) 1 (2) 2
(3) 3 (4) 4

28. If $\cos\theta + \left(\frac{1}{\sqrt{3}}\right)\sin\theta = \frac{2}{\sqrt{3}}$, then find θ in circular measure.

- (1) $\frac{\pi^2}{2}$ (2) $\frac{\pi^2}{3}$
(3) $\frac{\pi^2}{4}$ (4) $\frac{\pi^2}{6}$

29. $\operatorname{cosec}(7\pi + \theta) \sin(8\pi + \theta) = \underline{\hspace{2cm}}$.

- (1) 0 (2) 1
(3) -1 (4) 2

30. If A and B are two supplementary angles, then $\sec^2 A - \tan^2 B = \underline{\hspace{2cm}}$.

- (1) 0 (2) 1
(3) -1 (4) 2

31. The possibility among the following is _____.

- (1) $\sin^2\theta = 4$ (2) $\cos^2\theta = 8$
(3) $\sin\theta = -8$ (4) $\operatorname{cosec}^2\theta = 4$

32. $\sin 25^\circ + \cos 115^\circ = \underline{\hspace{2cm}}$.

- (1) 1 (2) 0
(3) -1 (4) $\sqrt{3}/2$

33. Find the value of $\cos 420^\circ$.

- (1) 1 (2) 0
(3) -1 (4) $\frac{1}{2}$

34. Which of the following statements are false?

- (a) $\sin^2\theta = 1.44$ (2) $\cos^2\theta = 1.69$
(c) $\operatorname{cosec}^2\theta = 0.25$ (4) All of these

35. If $x = \tan 1^\circ + \tan 2^\circ + \dots + \tan 45^\circ$ and $y = -(\cot 46^\circ + \cot 47^\circ + \dots + \cot 89^\circ)$, then find the value of $x + y$.

- (1) 1 (2) 0
(3) -1 (4) $\sqrt{3}/2$

36. If $\sin 53^\circ 21' = 0.8$, then $\cos 36^\circ 39' = \underline{\hspace{2cm}}$.

- (1) 0.2 (2) 0.4
(3) 0.6 (4) 0.8

37. A tower subtends an angle θ at a point P on the same level as the foot of the tower, and from a point h m above P, the depression of the foot of the tower is α . The height of the tower is (in m)

- (1) $h \tan \theta \tan \alpha$ (2) $h \cot \theta \cot \alpha$
 (3) $h \tan \theta \cot \alpha$ (4) $h \cot \theta \tan \alpha$

38. A vertically straight tree 12 m tall, is broken by wind in such a fashion that its top just touches the ground making an angle with the ground such that the cosine of the angle is 0.6 . At what height from the top did the tree break? (in m)

- (1) $20/3$ (2) $10/3$
 (3) $16/3$ (4) $8/3$

39. The angles of depression of the top and the bottom of a 10 m tall building, observed from the top of a tower

are 30° and 45° respectively. Find the height of the tower. (in m)

- (1) $20 + 5\sqrt{2}$ (2) $12 + 10\sqrt{2}$
 (3) $15 + 5\sqrt{3}$ (4) $18 + 3\sqrt{3}$

40. The angles of depression of two points from the top of the tower are 30° and 60° . If the height of the tower is 30 m, then find the maximum possible distance between the two points. (in m)

- (1) $20\sqrt{3}$ (2) $30\sqrt{3}$
 (3) $40\sqrt{3}$ (4) $50\sqrt{3}$

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. If the angles of a quadrilateral are in the ratio $1 : 2 : 3 : 4$, then the smallest angle in the centesimal system is _____.

- (1) 30^g (2) 40^g
 (3) 50^g (4) 60^g

2. $\frac{\pi^c}{5}$ in sexagesimal measure, is _____.

- (1) 18° (2) 36°
 (3) 54° (4) 72°

3. 160^g in circular measure, is _____.

- (1) $\frac{2\pi^c}{5}$ (2) $\frac{3\pi^c}{5}$
 (3) $\frac{4\pi^c}{5}$ (4) π^c

4. 30° in centesimal measure, is _____.

- (1) $\frac{50^g}{3}$ (2) $\frac{100^g}{3}$
 (3) $\frac{160^g}{3}$ (4) $\frac{200^g}{3}$

5. The value of $\frac{6\pi^c}{5}$ in sexagesimal measure is

- (1) 144° (2) 216°
 (3) 240° (4) 120°

6. A wheel makes 12 revolutions per hour. The radians it turns through in 20 minutes is _____.

- (1) $8\pi^c$ (2) $16\pi^c$
 (3) $24\pi^c$ (4) $32\pi^c$

7. The value of 108° in circular measure is _____.

- (1) $5\pi^c/3$ (2) $3\pi^c/5$
 (3) $\pi^c/5$ (4) $6\pi^c/7$

8. $1^\circ =$ _____ (approximately).

- (1) 0.0175^c (2) 57^c
 (3) 45^c (4) 1.75^c

9. The value of $\frac{\tan 29^\circ + \tan 31^\circ}{1 - \tan 29^\circ \tan 31^\circ}$ is _____.

- (1) 1 (2) $\frac{1}{\sqrt{3}}$
 (3) $\sqrt{3}$ (4) 0

10. $\sin^2 85^\circ + \sin^2 5^\circ =$ _____.

- (1) 0 (2) 1
 (3) $1/2$ (4) $2/3$

11. If $\operatorname{cosec}(20^\circ + x) = \sec(50^\circ + x)$, the value of x is

- (1) 10° (2) 20°
 (3) 30° (4) 40°

12. If $\sin \theta = 1/2$ and $0^\circ < \theta < 90^\circ$, then $\cos 2\theta =$ _____.

- (1) 0 (2) 1
 (3) $\frac{1}{2}$ (4) $\frac{\sqrt{3}}{2}$

13. ABC is a right isosceles triangle, right angled at B. Then $\sin^2 A + \cos^2 C =$ _____.

- (1) 0 (2) $\frac{1}{2}$
 (3) $\frac{1}{\sqrt{2}}$ (4) 1
14. The value of $\frac{\sin 20^\circ \cos 70^\circ + \cos 20^\circ \sin 70^\circ}{\sin 23^\circ \operatorname{cosec} 23^\circ + \cos 23^\circ \sec 23^\circ}$ is
 (1) 0 (2) 1
 (3) 2 (4) $\frac{1}{2}$
15. The value of $4(\sin^4 30^\circ + \cos^4 30^\circ) - 3(\cos^2 45^\circ + \sin^2 90^\circ)$ is _____.
 (1) $-\frac{1}{2}$ (2) -2
 (3) 2 (4) $\frac{1}{2}$
16. If $\sin^4 \theta + \cos^4 \theta = \frac{1}{2}$, then the value of $\sin \theta \cos \theta$ is
 (1) $\pm \frac{1}{8}$ (2) $\pm \frac{1}{4}$
 (3) ± 1 (4) $\pm \frac{1}{2}$
17. If $\sin \theta = \frac{3}{5}$ and θ is acute, then find the value of $\frac{\tan \theta - 2 \cos \theta}{3 \sin \theta + \sec \theta}$.
 (1) $\frac{15}{61}$
 (2) $\frac{17}{61}$
 (3) $-\frac{15}{61}$
 (4) $-\frac{17}{61}$
18. If $\sin(A + B) = \frac{\sqrt{3}}{2}$ and $\cot(A - B) = 1$, then find A.
 (1) $27\frac{1^\circ}{2}$ (2) $35\frac{1^\circ}{2}$
 (3) $52\frac{1^\circ}{2}$ (4) $55\frac{1^\circ}{2}$
19. Find the value of $\cos 15^\circ$.
 (1) $\frac{\sqrt{3}+1}{2\sqrt{2}}$ (2) $\frac{\sqrt{3}-1}{2\sqrt{2}}$
 (3) $\frac{\sqrt{2}+1}{2\sqrt{3}}$ (4) $\frac{\sqrt{2}-1}{2\sqrt{3}}$
20. If $\tan \theta - \cot \theta = 7$, find the value of $\tan^3 \theta - \cot^3 \theta$.
 (1) 284 (2) 296
 (3) 345 (4) 364
21. If $\tan \theta + \cot \theta = 2$, find the value of $\tan^{1025} \theta + \cot^{1025} \theta$.
 (1) 0 (2) 1
 (3) 2 (4) $\frac{1}{2}$
22. If $\sin \theta + \operatorname{cosec} \theta = 2$, find the value of $\cot \theta + \cos \theta$.
 (1) 0 (2) $\frac{1}{2}$
 (3) 1 (4) 2
23. If $\sin(A + B) = \frac{\sqrt{3}}{2}$ and $\cot(A - B) = \sqrt{3}$, then find the value of
 (1) 15° (2) 30°
 (3) 10° (4) 20°
24. $\frac{\cot A + \operatorname{cosec} A - 1}{\cot A - \operatorname{cosec} A + 1}$ _____.
 (1) $\frac{1 - \cos A}{\sin A}$ (2) $\frac{1 + \sin A}{\cos A}$
 (3) $\frac{1 - \sin A}{\cos A}$ (4) $\frac{1 + \cos A}{\sin A}$
25. If $\sec \theta + \tan \theta = 2$, then find the value of $\sin \theta$, where $0^\circ < \theta < 90^\circ$.
 (1) $\frac{2}{5}$ (2) $\frac{3}{5}$
 (3) $\frac{4}{5}$ (4) 1
26. $\sin \theta - \sqrt{3} \cos \theta =$
 (1) $\sin(\theta + 60^\circ)$ (2) $\sin(\theta - 60^\circ)$
 (3) $2 \sin(\theta + 60^\circ)$ (4) $2 \sin(\theta - 60^\circ)$
27. Find the value of $\tan(22\frac{1}{2}^\circ)$.
 (1) $\sqrt{2} - 1$ (2) $\sqrt{2} + 1$
 (3) $\sqrt{3} - 1$ (4) $\sqrt{3} + 1$
28. $[\sin(x - \pi) + \cos(x - \frac{\pi}{2})] \cdot \cos(x - 2\pi) =$ _____.
 (1) 0 (2) 1
 (3) $\frac{1}{\sqrt{2}}$ (4) $\frac{\sqrt{3}}{2}$
29. If ABCD is a cyclic quadrilateral, then $\tan A + \tan C$ is
 (1) 0 (2) 1
 (3) -1 (4) 2
30. $[\sin \alpha + \sin(180^\circ - \alpha) + \sin(180^\circ + \alpha)] \operatorname{cosec} \alpha =$ _____.
 (1) 0 (2) 1
 (3) 2 (4) 3
31. Which of the following functions is never negative?
 (1) $\sin x^2 + \cos y^2$
 (2) $\sin x^4 + \cos y^4$
 (3) $\sin |x| - \cos |x|$
 (4) $(\sin x + \cos x)^2$

32. If $\operatorname{cosec} \theta = -\sqrt{2}$ and $\tan \theta = -1$, $\cos \theta$ is
 (1) $\frac{1}{\sqrt{2}}$ (2) $\frac{\sqrt{3}}{2}$
 (3) 1 (4) $\frac{1}{2}$
33. If $\sin A = 3/5$ and A is not in the first quadrant, then find $\frac{\cos A + \sin 2A}{\tan A + \sec A}$.
 (1) $16/25$ (2) $17/25$
 (3) $22/25$ (4) $19/25$
34. If $\cos \theta_1 + \cos \theta_2 + \cos \theta_3 = 3$, find $\sin \theta_1 + \sin \theta_2 + \sin \theta_3$.
 (1) 0 (2) 1
 (3) 2 (4) 3
35. $\sin^2 5^\circ + \sin^2 10^\circ + \sin^2 15^\circ + \dots + \sin^2 90^\circ =$
 (1) $17/2$ (2) $19/2$
 (3) $21/2$ (4) $23/2$
36. $\sin^2 (43^\circ 24') + \sin^2 (46^\circ 36') =$ _____.
 (1) 0.3 (2) 0.5
 (3) 1.2 (4) 1
37. From a point at a height h m above a lake, the angle of elevation of a cloud is α and the angle of depression of its reflection in the lake is β . The height of the cloud above the surface of the lake is
 (1) $\frac{h \cos(\alpha + \beta)}{\cos(\alpha - \beta)} m$ (2) $\frac{h \sin(\alpha + \beta)}{\cos(\alpha - \beta)} m$
 (3) $\frac{h \sin(\alpha - \beta)}{\cos(\alpha + \beta)} m$ (4) $\frac{h \sin(\alpha + \beta)}{\sin(\beta - \alpha)} m$
38. A man on the top of a rock observed a boat coming towards the rock with a uniform speed. It takes 15 minutes for the angle of depression to change from 30° to 60° , then what time will the boat take to reach the shore?
 (1) 5 minutes (2) 10 minutes
 (3) $7\frac{1}{2}$ minutes (4) $2\frac{1}{2}$ minutes
39. If the sun ray's inclination increases from 45° to 60° , the length of the shadow of a tower decreases by 50 m. Find the height of the tower.
 (1) $25(\sqrt{3} + 1)$
 (2) $25(3 + \sqrt{3})$
 (3) $50(\sqrt{3} + 1)$
 (4) $30(3 + \sqrt{3})$
40. AB is a vertical pole. The end A is on the level ground. C is the mid point of AB. P is a point on the level ground such that the portion BC subtends an angle θ at P. If $AP = nAB$, then the value of $\cot \theta$ is
 (1) $\frac{2n^2 + 1}{n}$
 (2) $\frac{n}{2n^2 + 1}$
 (3) $\frac{2n^2 + 1}{2n}$
 (4) $\frac{2n}{2n^2 + 1}$

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

1. 3	2. 2	3. 2	4. 1	5. 3	6. 2	7. 3	8. 2	9. 2	10. 2
11. 3	12. 4	13. 2	14. 3	15. 3	16. 2	17. 1	18. 1	19. 3	20. 4
21. 1	22. 1	23. 4	24. 3	25. 4	26. 1	27. 2	28. 4	29. 3	30. 2
31. 4	32. 2	33. 4	34. 4	35. 1	36. 4	37. 3	38. 1	39. 3	40. 3

PRACTICE EXERCISE 5 (B)

1. 2	2. 2	3. 3	4. 2	5. 2	6. 1	7. 2	8. 1	9. 3	10. 2
11. 1	12. 3	13. 4	14. 4	15. 2	16. 4	17. 4	18. 3	19. 1	20. 4
21. 3	22. 1	23. 1	24. 4	25. 2	26. 4	27. 1	28. 1	29. 1	30. 2
31. 4	32. 1	33. 3	34. 1	35. 2	36. 4	37. 4	38. 3	39. 2	40. 1

Coordinate Geometry

SYNOPSIS

Convention of Signs

If (x, y) is a point in the plane and Q_1, Q_2, Q_3, Q_4 are the four quadrants of rectangular coordinate system, then

- (1) If $x > 0$ and $y > 0$, then $(x, y) \in Q_1$;
- (2) If $x < 0$ and $y > 0$, then $(x, y) \in Q_2$;
- (3) If $x < 0$ and $y < 0$, then $(x, y) \in Q_3$;
- (4) If $x > 0$ and $y < 0$, then $(x, y) \in Q_4$.

Point on the x-axis and the y-axis

Let P be a point on the x-axis, so that its distance from the x-axis is zero. Hence, the point P can be taken as $(x, 0)$.

Let P^1 be a point on the y-axis, so that its distance from the y-axis is zero. Hence, the point P can be taken as $(0, y)$.

- The distance between two points $A(x_1, y_1)$ and $B(x_2, y_2)$ is $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ units.
- **Inclination of a line:** The angle made by a straight line with the x-axis in the anti-clockwise direction is called its inclination.
- The slope of a line passing through the points (x_1, y_1) and (x_2, y_2) is, $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Note:

If the points A, B and C are collinear, then the slope of AB = the slope of BC . i.e., if $m_1 = m_2$, then A, B and C are collinear.

- **Slope or Gradient of a line:** If θ is the inclination of a line L , then its slope is denoted by m and is given by $m = \tan\theta$

θ	0°	30°	45°	60°	90°	120°	135°	150°
$m = \tan \theta$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	∞	$-\sqrt{3}$	-1	$-1/\sqrt{3}$

The following table gives the inclination (θ) of the line and its corresponding slope (m) for some particular values of θ .

Equations of some Standard Lines

The equation of the x-axis is $y = 0$.

The equation of the y-axis is $x = 0$.

The equation of a line parallel to the x-axis at a distance of k units from it is $y = k$

The equation of a line parallel to the y-axis and at a distance of k units from it is $x = k$.

Different forms of Equations of Oblique Lines

- 1. Gradient form (or) slope form:** The equation of a straight line with slope m and passing through origin is given by $y = mx$.
- 2. Point – slope form:** The equation of a straight line passing through the point (x_1, y_1) and with slope m is given by $y - y_1 = m(x - x_1)$.
- 3. Slope – intercept form:** The equation of a straight line with slope m and having y -intercept c is given by $y = mx + c$.
- 4. Two-point form:** The equation of a straight line passing through the points (x_1, y_1) and (x_2, y_2) is given by $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

Note: Area of triangle formed by the line $\frac{x}{a} + \frac{y}{b} = 1$ with the coordinate axes is $\frac{1}{2}|ab|$ sq units.

- **Area of triangle:** Consider $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ are the vertices of $\triangle ABC$.

$$\Delta = \frac{1}{2} \begin{vmatrix} x_1 - x_2 & y_1 - y_2 \\ x_2 - x_3 & y_2 - y_3 \end{vmatrix} \text{ sq units.}$$

- **Area of a quadrilateral:** Area of a quadrilateral with vertices (x_1, y_1) , (x_2, y_2) , (x_3, y_3) and (x_4, y_4) is given by $\frac{1}{2} \begin{vmatrix} x_1 - x_3 & y_1 - y_3 \\ x_2 - x_4 & y_2 - y_4 \end{vmatrix}$.

- **Equation of a line parallel or perpendicular to the given line:** Let $ax + by + c = 0$ be the equation of a straight line, then,

- (i) The equation of a line passing through the point (x_1, y_1) and parallel to the given line is given by $a(x - x_1) + b(y - y_1) = 0$.

- (ii) The equation of a line passing through the point (x_1, y_1) and perpendicular to the given line is given by $b(x - x_1) - a(y - y_1) = 0$.

Section Formula

If the coordinates of 'C' are $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right)$

C divides line segment joining $A(x_1, y_1)$; $B(x_2, y_2)$ in the ratio $m : n$ internally,

Note:

- (1) When C does not lie between A and B i.e., as shown below, then we say that C divides AB in $m : n$ ratio externally then the coordinates of C are

$$\left(\frac{mx_2 - nx_1}{m-n}, \frac{my_2 - ny_1}{m-n} \right)$$

A ——— B ——— C

- (2) Let $P(x, y)$ divides the line segment joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m : n$.

$$\text{Then, } \frac{m}{n} = \frac{x - x_1}{x_2 - x} \text{ (or) } \frac{y - y_1}{y_2 - y}$$

- (3) X-axis divides the line joining the points (x_1, y_1) and (x_2, y_2) in the ratio $-y_1 : y_2$ (or) $y_1 : -y_2$.
- (4) Y-axis divides the line joining the points (x_1, y_1) and (x_2, y_2) in the ratio $-x_1 : x_2$.
- (5) The mid-point of the line segment joining the points (x_1, y_1) and (x_2, y_2)

$$= \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Solved Examples

1. Find a if the distance between the points $P(11, -2)$ and $Q(a, 1)$ is 5 units.

✎ **Solution:** Distance between two points (x_1, y_1) ,

$$(x_2, y_2) \text{ is } \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

Given, $PQ = 5$,

$$\Rightarrow \sqrt{(a - 11)^2 + (1 - (-2))^2} = 5$$

Taking square on both sides, we get

$$(a - 11)^2 = 25 - 9 = 16 \Rightarrow a - 11$$

$$= \pm \sqrt{16} = a - 11 = \pm 4$$

$$\Rightarrow a = 15 \text{ or } 7$$

2. Find the coordinates of a point on the y -axis which is equidistant from the points $(13, 2)$ and $(12, -3)$.

✎ **Solution:** Let $P(0, y)$ be the required point and the given points be $A(12, -3)$ and $B(13, 2)$. Then $PA = PB$ (given)

$$\sqrt{(12-0)^2 + (-3-y)^2} = \sqrt{(13-0)^2 + (2-y)^2}$$

$$\Rightarrow \sqrt{144 + (y+3)^2} = \sqrt{169 + (2-y)^2}$$

$$\Rightarrow y = 2$$

\therefore The required point on Y-axis is (0, 2).

3. Find the area of the triangle formed by the mid-points of the sides of $\triangle ABC$, where $A = (3, 2)$, $B = (-5, 6)$ and $C = (8, 3)$.

$$\begin{aligned} \text{Solution: Area of } \triangle ABC &= \frac{1}{2} \begin{vmatrix} 3 & -5 & 2-6 \\ -5 & 8 & 6-3 \\ 2 & -13 & 3 \end{vmatrix} \\ &= \frac{1}{2} \begin{vmatrix} 8 & -4 \\ -13 & 3 \end{vmatrix} \end{aligned}$$

$$= \frac{1}{2} |8(3) - 4(13)| = \frac{1}{2} |24 - 52| = 14 \text{ sq. units.}$$

Hence the area of triangle formed by the mid-points of the sides of $\triangle ABC = \frac{1}{4}(\text{Area of } \triangle ABC) = \frac{1}{4}(14) = 3.5 \text{ sq. units.}$

4. Find the area of the circle whose centre is $(-3, 2)$ and $(2, 5)$ is a point on the circle.

Solution: Let the centre of the circle be $A(-3, 2)$ and the point of circumference be $B(2, 5)$

Radius of the circle = AB

$$= \sqrt{(2+3)^2 + (5-2)^2} = \sqrt{25+9}$$

$$r = \sqrt{34} \text{ units.}$$

\therefore The area of circle = $\pi r^2 = 34\pi$ sq. units.

5. Find the area of square whose one pair of the opposite vertices are $(3, 4)$ and $(5, 6)$.

Solution: Let the given vertices be $A(3, 4)$ and $C(5, 6)$.

$$\text{Length of } AC = \sqrt{(3-5)^2 + (4-6)^2} = \sqrt{8} \text{ units}$$

Area of the square

$$= \frac{AC^2}{2} = \frac{(\sqrt{8})^2}{2} = 4 \text{ sq. units.}$$

6. Find the orthocentre of the $\triangle ABC$ formed by the vertices $A(2, 2)$, $B(6, 3)$ and $C(4, 11)$.

Solution: The given vertices of $\triangle ABC$ are

$A(2, 2)$, $B(6, 3)$ and $C(4, 11)$.

$$AB = \sqrt{(6-2)^2 + (3-2)^2}$$

$$= \sqrt{17} \text{ units}$$

$$BC = \sqrt{(6-4)^2 + (3-11)^2} = \sqrt{68} \text{ units}$$

$$\text{Length of } AC = \sqrt{(4-2)^2 + (11-2)^2}$$

$$= \sqrt{85} \text{ units}$$

Clearly, $AC^2 = AB^2 + BC^2$. $\triangle ABC$ is a right triangle, right angle at B .

Hence orthocentre is the vertex containing right angle i.e., $B(6, 3)$.

7. If the points $(-3, 6)$, $(-9, a)$ and $(0, 15)$ are collinear, then find a .

Solution: Let the given points be $A(-3, 6)$, $B(-9, a)$ and $C(0, 15)$.

Since the points A , B and C are collinear, the slope

of $\overleftrightarrow{AB} = \text{slope of } \overleftrightarrow{BC}$

$$\Rightarrow \frac{6-a}{6} = \frac{15-a}{9}$$

$$\Rightarrow 18 - 3a = 30 - 2a \Rightarrow a = -12.$$

8. Find the equation of a line passing through the point $A(2, -3)$ and parallel to the line $2x - 3y + 6 = 0$.

Solution: Here, $(x_1, y_1) = (2, -3)$, $a = 2$ and $b = -3$.

\therefore Equation of the line passing through $A(2, -3)$ and parallel to the line $2x - 3y + 6 = 0$ is

$$a(x - x_1) + b(y - y_1) = 0. \text{ i.e., } 2(x - 2) - 3(y + 3) = 0 \Rightarrow 2x - 3y - 13 = 0.$$

Hence, the equation of the required line is

$$2x - 3y - 13 = 0$$

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The distance between $(-4, -5)$ and $(-4, -10)$ is _____ units.
 (1) 15 (2) 10
 (3) 5 (4) 2
2. $(0, 0)$, $(0, 3)$ and $(3, 0)$ form
 (1) a straight line
 (2) an equilateral triangle
 (3) a scalene triangle
 (4) a right triangle
3. Find the perimeter of the triangle formed by the points $(3, 5)$, $(4, 8)$ and $(5, 6)$.
 (1) $\sqrt{5}(2+\sqrt{2})$ (2) $\sqrt{3}(2+\sqrt{2})$
 (3) $\sqrt{2}(5+\sqrt{3})$ (4) $\sqrt{5}(\sqrt{2}+\sqrt{3})$
4. Find the point on the y-axis which is equidistant from $A(3, -6)$ and $B(-2, 5)$.
 (1) $\left(\frac{9}{11}, 0\right)$ (2) $\left(0, \frac{8}{11}\right)$
 (3) $\left(0, \frac{-8}{11}\right)$ (4) $\left(0, \frac{9}{11}\right)$
5. Points $(-3, -3)$, $(4, -1)$, $(6, 6)$ and $(-1, 4)$ when joined in the given order form a _____.
 (1) parallelogram (2) rectangle
 (3) rhombus (4) square
6. Find the slope of $x \cot \alpha - y \tan \alpha = 1$.
 (1) $\operatorname{cosec}^2 \alpha - 1$ (2) $\sec^2 \alpha - 1$
 (3) $\tan^2 \alpha - 1$ (4) $\cot^2 \alpha - 1$
7. If the slope of the line joining the points $(3, -9)$ and $(p, 2p+3)$ is $-5/7$, then find the value of p .
 (1) $23/4$ (2) $99/4$
 (3) $-23/4$ (4) $-99/4$
8. One end of a diagonal of a square is $(2, 0)$ and its slope is 1. If the length of the side of a square is 2 units, then write all the possible coordinates of the other end.

(1) $(4, 2)$	(2) $(0, 2)$
(3) $(2, 4)$	(4) $(-2, 0)$
9. If $l_1 \perp l_2$ and the slope of l_1 is $1/2$, then the slope of l_2 is _____.
 (1) 2 (2) -2
 (3) 1 (4) -1
10. If the inclination of a line is 45° , then the slope of the line is _____.
 (1) 0 (2) -1
 (3) 1 (4) 2
11. The slope of the y-axis is _____.
 (1) 1 (2) -1
 (3) 2 (4) Not defined
12. The slope of any line which is parallel to the x-axis is _____.
 (1) 0 (2) 1
 (3) -1 (4) 2
13. If the two straight lines, $y = m_1x + c_1$ and $y = m_2x + c_2$ are perpendicular to each other, then $m_1m_2 =$ _____.
 (1) -1 (2) 0
 (3) $1/2$ (4) 2
14. The area of a triangle formed by coordinate axes with the line $ax + by + c = 0$ is _____.
 (1) c/ab (2) $c/2ab$
 (3) c^2/ab (4) $c^2/2ab$
15. The slope of a line perpendicular to $5x + 3y + 1 = 0$ is _____.
 (1) $-5/3$ (2) $5/3$
 (3) $-3/5$ (4) $3/5$
16. The area of a triangle formed by $(0, 0)$, $(0, a)$ and $(b, 0)$ is _____.
 (1) ab (2) $\frac{ab}{2}$
 (3) $\left|\frac{ab}{2}\right|$ (4) $|ab|$

17. The line parallel to $3x + 4y + 7 = 0$ and passing through $(1, 2)$ is _____.
 (1) $3x + 4y + 11 = 0$ (2) $4x - 3y + 11 = 0$
 (3) $3x + 4y - 11 = 0$ (4) $x + y - 3 = 0$
18. Which of the following statements is true?
 (1) Intercept made by $ax + by + c = 0$ on the x-axis is c/a .
 (2) The line $y = mx$ passes through the origin.
 (3) The line $y = \frac{1}{\sqrt{3}}x + 4$ makes an angle of 60° with the x-axis.
 (4) The line $x = 7$ is parallel to x-axis.
19. The line parallel to $4x + 3y + 7 = 0$ and passing through $(2, 1)$ is _____.
 (1) $4x + 3y + 11 = 0$ (2) $4x + 3y + 8 = 0$
 (3) $4x + 3y - 8 = 0$ (4) $4x + 3y - 11 = 0$
20. The lines $x = -2$ and $y = 1$ intersect
 (1) at the point $(2, -1)$
 (2) in the third quadrant.
 (3) at the point $(0, 0)$.
 (4) In the second quadrant.
21. Find the equation of a straight line whose slope is -5 and making an intercept 3 on the y-axis.
 (1) $5x + y = 3$ (2) $x + 5y = 3$
 (3) $5x - y = 3$ (4) $x - 5y = 3$
22. Find the area of the triangle formed by the line $4x + 5y + 7 = 0$ with the coordinate axis.
 (1) $51/40$ (2) $49/40$
 (3) $39/40$ (4) $31/40$
23. Find the equation of a line parallel to the line $2x + 3y - 6 = 0$ and where the sum of intercepts is 10.
 (1) $2x + 3y = 12$ (2) $x + 3y = 9$
 (3) $3x + 2y = 8$ (4) $2x + 3y = 8$
24. Find the area of the quadrilateral formed by the vertices $(-4, -2)$, $(2, -2)$, $(4, 2)$ and $(-2, 2)$.
 (1) 12 (2) 24
 (3) 36 (4) 18
25. The end points of a diagonal of a parallelogram are $(1, 3)$ and $(5, 7)$, then the mid-point of the other diagonal is _____.
 (1) $(1, 7)$ (2) $(3, 5)$
 (3) $(5, 3)$ (4) $(7, 1)$
26. The coordinates of the points P which divides $(1, 0)$ and $(0, 0)$ in 1: 2 ratio are _____.
 (1) $(2, 3)$ (2) $\left(\frac{2}{3}, 3\right)$
 (3) $(3, 2)$ (4) $\left(\frac{2}{3}, 0\right)$
27. The centroid of a triangle formed by the lines $x = 0$, $y = 0$ and $x + y = 6$ is _____.
 (1) $(2, 0)$ (2) $(0, 3)$
 (3) $(3, 3)$ (4) $(2, 2)$
28. The medians of a triangle meet at $(1, 1)$ and two of its vertices are $(2, 5)$ and $(4, 6)$.
 Then the third vertex of the triangle is _____.
 (1) $(-3, -8)$ (2) $(3, 8)$
 (3) $(0, -3)$ (4) $(3, 5)$
29. The status of the points $(1, 5)$ and $(5, 1)$ with respect to the line $x - y = 0$ is _____.
 (1) both lie on the same side
 (2) both lie on the opposite side
 (3) both lie on the line
 (4) only one of them lie on the line
30. Let $A(-1, 2)$ and $D(3, 4)$ be the end points of the median AD of $\triangle ABC$. Find the centroid of $\triangle ABC$.
 (1) $(5, 10)$ (2) $(5, 3)$
 (3) $\left(\frac{10}{3}, 0\right)$ (4) $\left(\frac{5}{3}, \frac{10}{3}\right)$
31. Find the circumcentre of the triangle whose vertices are $(0, 0)$, $(3, \sqrt{3})$ and $(0, 2\sqrt{3})$.
 (1) $(1, \sqrt{3})$
 (2) $(-1, \sqrt{3})$
 (3) $(0, \sqrt{3})$
 (4) $(1, 2\sqrt{3})$
32. Find the area of a triangle ABC, whose vertices are $A(-2, 2)$, $B(5, 2)$ and whose centroid is $(1, 3)$.
 (1) $21/2$ (2) $23/2$
 (3) $19/2$ (4) $25/2$
33. Find the co-ordinates of a point C on AB produced, so that $3AB = AC$, where $A = (3, 2)$ and $B = (-2, 4)$.
 (1) $(-12, 8)$ (2) $(8, 12)$
 (3) $(12, 8)$ (4) $(-8, 12)$

34. Find the equation of the perpendicular bisector drawn to the side BC of $\triangle ABC$, whose vertices are $A(-2, 1)$, $B(2, 3)$ and $C(4, 5)$.

(1) $x + y = 7$
 (2) $x - y = 5$
 (3) $x - y = 7$
 (4) $x + y = 9$

35. $A = (2, 2)$, $B = (2, 5)$ and $C = (5, 2)$ form a triangle. The circumcentre of $\triangle ABC$ is

(1) $(3, 3)$
 (2) $(2, 2)$
 (3) $(3.5, 3.5)$
 (4) $(2.5, 2.5)$

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. $(0, 0)$, $(0, 3)$ and $(3, 0)$ form

(1) collinear points.
 (2) an equilateral triangle.
 (3) a scalene triangle.
 (4) a right triangle.

2. The distance between $(2, 3)$ and $(-4, 5)$ is _____.

(1) $2\sqrt{2}$ (2) $2\sqrt{10}$
 (3) $2\sqrt{17}$ (4) $\sqrt{10}$

3. Find the distance between $(3, -5)$ and $(-4, 7)$.

(1) $\sqrt{144}$ (2) $\sqrt{193}$
 (3) $\sqrt{169}$ (4) $\sqrt{133}$

4. The points $(6, 2)$, $(2, 5)$ and $(9, 6)$ form the vertices of a _____ triangle.

(1) right
 (2) equilateral
 (3) right isosceles
 (4) scalene

5. Find the radius of the circle which passes through the origin, $(0, 4)$ and $(4, 0)$.

(1) $\sqrt{8}$ (2) 4
 (3) 16 (4) $\sqrt{32}$

6. Find the slopes of the line whose inclination is 135° .

(1) 1 (2) -1
 (3) $\sqrt{3}$ (4) $-\sqrt{3}$

7. Find the slope of the line perpendicular to \overleftrightarrow{AB} where $A(5, -6)$ and $B(2, -7)$.

(1) -2 (2) -3
 (3) 1 (4) 2

8. The area of the triangle formed by the points $(2, 6)$, $(10, 0)$ and $(0, k)$ is zero square units. Find the value of k .

(1) $15/2$ (2) $3/2$
 (3) $7/2$ (4) $13/2$

9. The slope of the x-axis is _____.

(1) 0 (2) 1
 (3) -1 (4) $\sqrt{3}$

10. The slope of any line which is perpendicular to the x-axis is _____.

(1) 0 (2) 1
 (3) -1 (4) Not defined

11. If $m_1 \parallel m_2$ and the slope of m_1 is $3/4$, then the slope of m_2 is _____.

(1) $3/4$ (2) $-3/4$
 (3) $4/3$ (4) $-4/3$

12. The slope of the line joining $(1, 2)$ and $(1, 3)$ is _____.

(1) 1 (2) 0
 (3) -1 (4) Not defined

13. The area of a triangle, with the vertices $(1, 2)$, $(3, 4)$ and $(5, 6)$, is _____.

(1) 0 (2) 1
 (3) 2 (4) 5

14. If the line $ax + by + c = 0$ is such that $a = 0$ and $b, c \neq 0$, then the line is perpendicular to _____.

(1) x-axis (2) y-axis
 (3) $x + y = 1$ (4) $x = y$

15. The line $y + 7 = 0$ is parallel to _____.

(1) $x = 2$ (2) $x = 1$
 (3) $x = 5$ (4) x-axis

16. Area of a triangle whose vertices are (0, 0), (2, 3), (5, 8) is _____.
 (1) $1/2$ (2) 1
 (3) 2 (4) $3/2$
17. The line through (1, 5), parallel to x-axis is _____.
 (1) $x = 1$ (2) $y = 5$
 (3) $y = 1$ (4) $x = 5$
18. The point of intersection of $4x + 6y = 10$ and $9x + 5y = 14$ is _____.
 (1) $(-2, 3)$ (2) $(-1/9, 3)$
 (3) $(1, 1)$ (4) $(2, 1/3)$
19. The line through $(-5, 8)$ and parallel to the x-axis is _____.
 (1) $x + 5 = 0$. (2) $x = 5$
 (3) $y = 8$ (4) $y = -5$
20. Find the equation of a line passing through the points A(3, -5) and B(4, -8).
 (1) $3x + y = 4$ (2) $3x + 2y = 5$
 (3) $x + 3y = 4$ (4) $4x = 3y$
21. Find the equation of a line, whose inclination is 30° and making an intercept of $-3/5$ on the y-axis.
 (1) $\frac{5}{\sqrt{3}}$ (2) $\frac{5}{3}$
 (3) $\frac{5}{3\sqrt{3}}$ (4) $\frac{-5}{3}$
22. Find the equation of a line passing through the point (2, -3) and parallel to the line $2x - 3y + 8 = 0$.
 (1) $2x - 3y = 13$
 (2) $2x - 3y = 12$
 (3) $x - 3y = 4$
 (4) $3x - 2y = 7$
23. Find the area of $\triangle ABC$, in which A = (2, -1), B = (3, 4) and C = (-3, -2).
 (1) 3 (2) 4
 (3) 7 (4) 12
24. If (5, 7) and (9, 3) are the end points of a diameter of a circle, then the centre of the circle is _____.
 (1) $(-5, -7)$ (2) (4, 4)
 (3) (7, 5) (4) (14, 10)
25. If (1, 2), (3, 4) and (0, 6) are the three vertices of a parallelogram taken in that order, then the fourth vertex is _____.
 (1) (2, 4) (2) $(-2, 4)$
 (3) (4, 2) (4) $(-4, 2)$
26. If the points (5, 5), (7, 7) and (a, 8) are collinear, then the value of a is _____.
 (1) 6 (2) 3
 (3) 5 (4) 7
27. If (1, 2), (3, 5) and (2, 5) are the vertices of a triangle, its centroid is _____.
 (1) (3, 4) (2) (2, 4)
 (3) (4, 2) (4) (6, 3)
28. If (3, 4), (5, 6) and (2, 8) are the three vertices of a parallelogram taken in order, then the fourth vertex is _____.
 (1) (6, 0) (2) (0, 6)
 (3) (0, 0) (4) (1, 5)
29. Let $(-3, 2)$ be one end of a diameter of a circle with centre (4, 6). Find the other end of the diameter.
 (1) (11, 10)
 (2) (10, 2)
 (3) (1, 1)
 (4) (7, 5)
30. Let A(3, -2) and B(2, 5) be two vertices of $\triangle ABC$. If the medians of $\triangle ABC$ intersect at (5, 2), then find the vertex C.
 (1) (3, 10)
 (2) (10, 3)
 (3) (7, 3)
 (4) (3, 7)
31. Find the circumcentre of the triangle formed by the points (2, 3), (1, -5) and $(-1, 4)$.
 (1) $\left(\frac{7}{10}, \frac{9}{10}\right)$ (2) $\left(\frac{-7}{10}, \frac{9}{10}\right)$
 (3) $\left(\frac{7}{10}, \frac{-9}{10}\right)$ (4) $\left(\frac{-9}{10}, \frac{-7}{10}\right)$
32. Find the equation of a line passing through the point of concurrence of medians of $\triangle ABC$, and parallel to \overline{AB} where A $(-4, 3)$ B (7, 1) and C (0, 2).
 (1) $2x + 11y = 24$
 (2) $x + y = 11$
 (3) $2x + y = 27$
 (4) $x + 3y = 15$
33. If P (1, -2) is the mid-point of the portion of a line intercepted between the coordinate axes, then find the equation of the straight line.
 (1) $x - y = 4$ (2) $2x - y = 4$
 (3) $x - 2y = 5$ (4) $2x - y = 5$

34. Let A (3, 2), B (−4, 1), C (−3, 1) and D (2, −4) be the vertices of a quadrilateral ABCD. Find the area of the quadrilateral formed by the mid-points of the sides of the quadrilateral ABCD.

- (1) 7 (2) 8
(3) 9 (4) 10

35. The inclination of a line is 30° , then the slope of the line is _____.

- (1) 0 (2) 1
(3) $\sqrt{3}$ (4) $\frac{1}{\sqrt{3}}$

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 1 | 4. 3 | 5. 3 | 6. 1 | 7. 3 | 8. 1 | 9. 2 | 10. 3 |
| 11. 4 | 12. 1 | 13. 1 | 14. 4 | 15. 4 | 16. 3 | 17. 3 | 18. 2 | 19. 4 | 20. 4 |
| 21. 1 | 22. 2 | 23. 1 | 24. 2 | 25. 2 | 26. 4 | 27. 4 | 28. 1 | 29. 2 | 30. 4 |
| 31. 1 | 32. 1 | 33. 1 | 34. 1 | 35. 3 | | | | | |

PRACTICE EXERCISE 6 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 2 | 4. 3 | 5. 1 | 6. 2 | 7. 2 | 8. 1 | 9. 1 | 10. 4 |
| 11. 1 | 12. 4 | 13. 1 | 14. 2 | 15. 4 | 16. 1 | 17. 2 | 18. 3 | 19. 3 | 20. 1 |
| 21. 3 | 22. 1 | 23. 4 | 24. 3 | 25. 2 | 26. 3 | 27. 2 | 28. 2 | 29. 1 | 30. 2 |
| 31. 4 | 32. 1 | 33. 2 | 34. 3 | 35. 4 | | | | | |
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Sets, Relations and Functions

SYNOPSIS

- **Set:** A set is a well-defined collection of objects.
The number of elements in a set A is called its cardinal number. It is denoted by $n(A)$.
- **Subset and Superset:** Let A and B be two sets. If every element of set A is also an element of set B , then A is said to be a subset of B or B is said to be a superset of A . If A is a subset of B , then we write, $A \subseteq B$ or $B \supseteq A$.

Note:

- (i) The empty set is a subset of every set.
- (ii) Every set is a subset of itself.
- (iii) If a set A has n elements, then the number of subsets of A is 2^n .

- **Power set:** The set of all subsets of a set A is called its power set of A . It is denoted by $P(A)$.
- **Union of sets:** $A \cup B = \{x: x \in A \text{ or } x \in B\}$

Note:

- (i) If $A \subseteq B$, then $A \cup B = B$.
- (ii) $A \cup \mu = \mu$ and $A \cup \phi = A$
- (iii) $A \cup A' = \mu$

- **Intersection of sets:** $A \cap B = \{x: x \in A \text{ and } x \in B\}$

Note:

- (1) If A and B are disjoint sets, then $A \cap B = \phi$.
- (2) If $A \subseteq B$, then $A \cap B = A$.

$$(3) A \cap \mu = A \text{ and } A \cap \phi = \phi.$$

$$(4) A \cap A' = \phi$$

- **Difference of sets:** $A - B = \{x: x \in A \text{ and } x \notin B\}$

Note:

- (1) $A - B \neq B - A$ unless $A = B$
- (2) For any set A , $A' = \mu - A$.

- **Symmetric difference of sets:**

$$A \Delta B = \{x: x \in A \text{ and } x \notin B \text{ or } x \in B \text{ and } x \notin A\}$$

Note:

$$A \Delta B = (A - B) \cup (B - A) \text{ (or)}$$

$$A \Delta B = (A \cup B) - (A \cap B)$$

- **Relation:** Let A and B be two non-empty sets and $R \subseteq A \times B$. R is called a relation from the set A to B . (Any subset of $A \times B$ is called a relation from A to B).

Note:

- (1) If $n(A) = p$ and $n(B) = q$, then the number of relations possible from A to B is 2^{pq} .
- (2) If $(x, y) \in R$, then we write $x R y$ and read as x is related to y .

Domain and Range of a Relation

- (a) The set of first coordinates of all ordered pairs in R is called the domain of R .
- (b) The set of second coordinates of all ordered pairs in R is called the range of R .

- **Inverse of a relation:** Let R be a relation from A to B . The inverse relation of R , denoted by R^{-1} , is defined as, $R^{-1} = \{(y, x)/(x, y) \in R\}$

Note:

- (1) Domain of R^{-1} = Range of R
- (2) Range of R^{-1} = Domain of R
- (3) If R is a relation from A to B , then R^{-1} is a relation from B to A .
- (4) If $R \subseteq A \times A$, then R is called a binary relation or simply a relation on the set A .
- (5) For any relation R , $(R^{-1})^{-1} = R$.

Properties of Relations

- (i) A relation R on a set A is said to be reflexive if for every $x \in A$, $(x, x) \in R$.
Note: The number of reflexive relations defined on set having n elements is 2^{n^2-n}
 - (ii) A relation R on a set A is said to be symmetric, if for every $(x, y) \in R$, $(y, x) \in R$.
 - (iii) A relation R on a set A is said to be transitive, for all $(x, y), (y, z) \in R$, if there exists $(x, z) \in R$.
- **Identity relation:** A relation R on a set A defined as, $R = \{(x, x)/x \in A\}$ is called an identity relation on A . It is denoted by I_A .

Note:

- (1) If $(a, b) \in f$ then $f(a) = b$ and b is called the image of a . a is called the pre image of b .
 - (2) If $f: A \rightarrow B$ is a function, then A is called the domain of f and B is called the co-domain of f .
 - (3) The set $f(A)$ which is all the images of elements of A under the mapping f is called the range of f .
- **Function:** Let A and B be two non-empty sets. A relation f from A to B is said to be a function, if every element in A is associated with exactly one element in B . It is denoted by $f: A \rightarrow B$ (read as is mapping from A to B). If $(a, b) \in f$, then b is called the f image of a and is written as $b = f(a)$. a is called the pre image of b . Also in $f(a) = b$, a is called the independent variable and b is called the dependent variable.
 - **Domain and Co-domain:** If $f: A \rightarrow B$ is a function, then A is called domain and B is the co-domain of the function.
 - **Range:** If $f: A \rightarrow B$ is a function, then the set of all images of elements in its domain is called the range of f and is denoted by $f(A)$
i.e., $f(A) = \{f(a)/a \in A\}$

Note:

- (i) Range of a function is always subset of its co-domain i.e., $f(A) \subseteq B$.
- (ii) If $f: A \rightarrow B$ is a function, and $n(A) = m$, $n(B) = p$, then the number of functions that can be defined from A to B is p^m

Types of Functions

One-one function or injection: Let $f: A \rightarrow B$ be a function. If different elements in A are assigned to different elements in B , then the function $f: A \rightarrow B$ is called a one-one function or an injection.

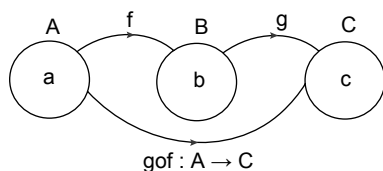
- **Many to one function:** If the function $f: A \rightarrow B$ is not one-one, then it is called a many to one function; i.e., two or more elements in A are assigned to the same element in B .
- **Onto function or surjection:** $f: A \rightarrow B$ is said to be an onto function, if every element in B is the image of at least one element in A . i.e., for every $b \in B$, there exists at least one element $a \in A$, such that $f(a) = b$.
Note: If $f: A \rightarrow B$ is an onto function, then the co-domain of f must be equal to the range of f . $f(A) = B$
- **Into function:** If a function is not onto, then it is an into function, i.e., at least one element in B is not the image of any element in A , or the range is a subset of the co-domain.
- **Bijective function:** If the function $f: A \rightarrow B$ is both one-one and onto then it is called a bijective function.
- **Inverse of a function:** If $f: A \rightarrow B$ is function, then the set of ordered pairs obtained by interchanging the first and second coordinates of each ordered pair in f is called the inverse of f and is denoted by f^{-1} . i.e., $f: A \rightarrow B$ is a function then its inverse is $f^{-1}: B \rightarrow A$
- **Inverse function:** If $f: A \rightarrow B$ is a bijective function then $f^{-1}: B \rightarrow A$ is also a function.
i.e., the inverse of a function is also a function, only when the given function is bijective.
- **Identity function:** $f: A \rightarrow A$ is said to be an identity function on A if $f(a) = a$ for every $a \in A$ it is denoted by I_A
- **Constant function:** A function $f: A \rightarrow B$ is a constant function if there is an element $b \in B$, such that $f(a) = b$, for all $a \in A$.
- **Equal Functions:** Two functions f and g , defined on the same domain D are said to be equal if $f(x) = g(x)$ for all $x \in D$.
- **Composite function (or) Product function:**
Let f and g be two functions such that $f: A \rightarrow B$ and $g: B \rightarrow C$. Let a be an arbitrary element in A .

Since f is a function from A to B , there exists an element $b \in B$ such that $f(a) = b$.

Since g is a function from B to C , there exists an element $c \in C$ such that $g(b) = c$.

$$\therefore g(f(a)) = c \Rightarrow \text{gof}(a) = c$$

\therefore gof is a function from A to C .



If $f: A \rightarrow B$ and $g: B \rightarrow C$ are two functions, then the function $g[f(x)] = \text{gof}$ from A to C , denoted by gof is called the composite function of f and g .

In the composite function gof ,

- (i) the co-domain of f is the domain of g .
- (ii) the domain of gof is the domain of f , the co-domain of gof is the co-domain of g .
- (iii) composite function does not satisfy commutative property i.e., $\text{gof} \neq \text{fog}$.
- (iv) if $f: A \rightarrow B$; $g: B \rightarrow C$; $h: C \rightarrow D$ are three functions, $\text{ho}(\text{gof}) = (\text{hog})\text{of}$

i.e., the composite function satisfies associative property.

- **Real function:** If $f: A \rightarrow B$ such that $A \subseteq \mathbb{R}$ then f is said to be a real variable function.

If $f: A \rightarrow B$ such that $B \subseteq \mathbb{R}$ then f is said to be a real valued function.

If $f: A \rightarrow B$, and A and B are both subsets of the set of real numbers (\mathbb{R}), then f is called a real function.

- **Even and odd functions:** If $f(-x) = f(x)$, then the function $f(x)$ is called an even function.

Function	Domain	Range
$\frac{1}{x}$	$\mathbb{R} - \{0\}$	\mathbb{R}
\sqrt{x}	$[0, \infty)$	$[0, \infty)$
$ x $	\mathbb{R}	$[0, \infty)$
$a^x (a > 0)$	\mathbb{R}	$(0, \infty)$

- **Graphs of functions:** A graph does not represent a function, if there exists a vertical line which meets the graph in two or more points, i.e., a vertical line meets the graph at only one point, then the graph represents a function.

- **Zeroes of a function:** If $f: A \rightarrow \mathbb{R} (A \subset \mathbb{R})$, then the points $k \in A$ such that $f(k) = 0$ are called the zeroes of the function f .

If k is a zero of $f: A \rightarrow \mathbb{R}$ then $(k, 0)$ is the corresponding point on the graph of f and k is called the x -intercept of the graph.

Solved Examples

1. The cardinal number of the power set of a non-empty set is 1024. Find the cardinal number of the set.

☞ **Solution:** $2^n = 1024 = 2^{10} \Rightarrow n = 10$
 \therefore The cardinal number of the set = 10

2. If $A = \{1, 3, 4, 6, 7\}$, $B = \{2, 5, 6, 8\}$ and a relation $R = \{(x, y) / (x, y) \in A \times B, y = 2x\}$, then write R in roster form.

☞ **Solution:** $R = \{(1, 2), (3, 6), (4, 8)\}$

3. If $f(x) = 3x^4 - 5x^2 + k$ where k is a constant, is an even function, then find the value of k .

☞ **Solution:** $f(x) = 3x^4 - 5x^2 + k$ is an even function.
 $f(-x) = 3(-x)^4 - 5(-x)^2 + k = 3x^4 - 5x^2 + k = f(x)$
 which is even.

\therefore It is not depending on k and it holds the same for any value of k . $\therefore k$ can be any real number.

4. If $f(x) = 2x^5 - 3x^3 + 7x + c$ where c is any real number, is an odd function, then find the value of c .

☞ **Solution:** $f(x) = 2x^5 - 3x^3 + 7x + c$ is odd

$$\begin{aligned} f(-x) &= 2(-x)^5 - 3(-x)^3 + 7(-x) + c \\ &= -2x^5 + 3x^3 - 7x + c \end{aligned}$$

$$f(-x) = -(2x^5 - 3x^3 + 7x - c) \text{ is odd only when } c = 0$$

5. Find the range of the function $f(x) = \frac{x^2 - 4}{x - 2}$ for $x \neq 2$.

☞ **Solution:** $f(x) = \frac{(x+2)(x-2)}{x-2} = x+2$ for $x \neq 2$

When $x \neq 2$, $f(2) = 4$ not possible

\therefore Range is $\mathbb{R} - \{4\}$

6. If $f(x) = x^6 + 3x^3 + 1$, then find $f\left(\frac{1}{x}\right)$ in terms of $f(x)$.

☞ **Solution:**

$$f\left(\frac{1}{x}\right) = \left(\frac{1}{x}\right)^6 + 3\left(\frac{1}{x}\right)^3 + 1 = \frac{1 + 3x^3 + x^6}{x^6} = \frac{f(x)}{x^6}$$

7. If $f(1) = 1$ and $f(x+1) = 2f(x) + 1$ for $x \geq 1$, then find the range of $f(x)$.

☞ **Solution:** $f(1+1) = 2f(1) + 1 = 3$ ($\because f(1) = 1$)
 $f(2+1) = 2f(2) + 1 = 2 \times 3 + 1 = 7$,
 $f(3+1) = 2f(3) + 1 = 2 \times 7 + 1 = 15$

The required range is 1, 3, 7, 15, 31,

8. If $f(x) = (1 - x^3)^{\frac{1}{3}}$, then find $f \circ f(x)$.

☞ **Solution:** $f(x) = (1 - x^3)^{\frac{1}{3}}$

$$f \circ f(x) = f[f(x)]$$

$$= f\left((1 - x^3)^{\frac{1}{3}}\right) = \left[1 - \left\{(1 - x^3)^{\frac{1}{3}}\right\}^3\right]^{\frac{1}{3}}$$

$$= [1 - (1 - x^3)]^{\frac{1}{3}} = (x^3)^{\frac{1}{3}} = x$$

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 20: Select the correct alternative from the given choices.

1. If X, Y and Z are any three non empty sets such that any two of them are disjoint, then $(X \cup Y \cup Z) \cap (X \cap Y \cap Z)$ is _____.
 (1) X (2) Y
 (3) Z (4) ϕ
2. If $(3p + q, p - q) = (p - q, 3p + q)$, then
 (1) $p = q = 0$ (2) $p = q$
 (3) $p = 2q$ (4) $p + q = 0$
3. If $n(A \times B) = 36$, then $n(A)$ can possibly be _____.
 (1) 7 (2) 8
 (3) 9 (4) 10
4. If $A = \{x, y, z\}$, then the relation $R = \{(x, x), (y, y), (z, z), (z, x), (z, y)\}$ is _____.
 (1) symmetric (2) anti-symmetric
 (3) transitive (4) Both (2) and (3)
5. The relation 'is a sister of' in the set of human beings is _____.
 (1) only transitive (2) only symmetric
 (3) equivalence (4) None of these
6. $a R b$ if "a and b are animals in different zoological parks," then R is
 (1) only reflexive (2) only symmetric
 (3) only transitive (4) equivalence
7. $a R b$ if "a and b are in same cage," then R is _____.
 (1) only reflexive (2) only symmetric
 (3) only transitive (4) equivalence
8. The domain of the function $f(x) = \frac{1}{\sqrt{x-3}}$ is
 (1) $x < 3$ (2) $x > 3$
 (3) $x \geq -3$ (4) $x \leq 3$
9. The domain of the function $f(x) = \log |x - 1|$ is _____.
 (1) $R - \{1, -1\}$ (2) $R - \{1\}$
 (3) $R - \{-1\}$ (4) $R - \{0\}$
10. If the curve $2x^2 + xy - y^2 - 3x + 4y + k = 0$ passes through the origin, then the value of k is _____.
 (1) 1 (2) -1
 (3) 0 (4) 2
11. If A and B are disjoint, then $(A \cap B)' =$ _____.
 (1) A (2) B
 (3) ϕ (4) μ
12. The number of non-empty proper subsets of a set containing 7 elements is _____.
 (1) 128 (2) 127
 (3) 126 (4) None of these
13. $\phi^c \cup \mu^c =$ _____.
 (1) ϕ
 (2) μ
 (3) None of these
 (4) Cannot be determined
14. The domain of the relation $R = \{(x, y): x, y \in N \text{ and } x + y \leq 3\}$ is _____.
 (1) $\{1, 2, 3\}$ (2) $\{1, 2\}$
 (3) $\{... -1, 0, 1, 2, 3\}$ (4) None of these
15. R is a relation on set A , then $[(R^{-1})^{-1}]^{-1}$ is _____.
 (1) R (2) R^{-1}
 (3) $A \times A$ (4) None of these
16. A relation, which satisfies reflexive, symmetric and transitive is _____ relation.
 (1) an identity (2) a constant
 (3) an equivalence (4) None of these
17. If $R = R^{-1}$, then the relation R is _____.
 (1) reflexive (2) symmetric
 (3) anti-symmetric (4) transitive
18. If f is a mapping from P to Q . The set of all the images of elements of P is called _____.
 (1) domain (2) co-domain
 (3) range (4) None of these
19. If f is an identity function, then $f(-5) =$ _____.
 (1) -5 (2) 1
 (3) -1 (4) None of these
20. If $f(x)$ an even function, then $f(-2) =$ _____.
 (1) 2 (2) -2
 (3) $f(2)$ (4) None of these

Directions for questions 21 and 22: These questions are based on the following data.

For any two sets A and B, $n(A) = 15$, $n(B) = 12$, $A \cap B \neq \phi$ and $B \not\subset A$.

21. Find the maximum possible value of $n(A \Delta B)$.

- (1) 27 (2) 26
(3) 24 (4) 25

22. Find the minimum possible value of $n(A \Delta B)$.

- (1) 3 (2) 4
(3) 5 (4) 6

Directions for questions 23 to 40: Select the correct alternative from the given choices.

23. There are 60 students in a class. The number of students who passed in Mathematics is 45 and the number of students who passed in Physics is 40. The number of students who failed in both the subjects is 5. Find the number of students who passed in exactly one of the subjects.

- (1) 35 (2) 25
(3) 15 (4) 5

24. If $R_n = \left\{ x : \frac{-1}{n} < x < \frac{1}{n} \right\}$, then $R_5 \cup R_{15} = \underline{\hspace{2cm}}$.

- (1) R_5 (2) R_{15}
(3) R_3 (4) R_{20}

25. The domain of the function, $f(x) = \frac{|x|-2}{|x|-3}$ is $\underline{\hspace{2cm}}$.

- (1) R
(2) $R - \{2, 3\}$
(3) $R - \{2, -2\}$
(4) $R - \{-3, 3\}$

26. If $f(x + y) = f(xy)$ and $f(1) = 5$, then find the value of $\sum_{k=0}^6 f(k)$.

- (1) 25 (2) 35
(3) 36 (4) 24

27. Find the domain of $f(x) = \frac{1}{\sqrt{2x^2 + 5x + 2}}$.

- (1) R
(2) $\left(-2, -\frac{1}{2}\right)$

$$(3) (-\infty, -2] \cup \left[\frac{-1}{2}, \infty\right)$$

$$(4) (-\infty, -2) \cup \left(\frac{-1}{2}, \infty\right)$$

28. If $f(x) + f(1 - x) = 10$, then the value of

$$f\left(\frac{1}{10}\right) + f\left(\frac{2}{10}\right) + \dots + f\left(\frac{9}{10}\right)$$

- (1) is 45
(2) is 50
(3) is 90
(4) Cannot be determined

29. If $X = \{2, 3, 5, 7, 11\}$ and $Y = \{4, 6, 8, 9, 10\}$, then find the number of one-one functions from X to Y.

- (1) 720 (2) 120
(3) 24 (4) 12

30. In a club of 70 members 30 play tennis but not cricket and 55 play tennis. How many members play cricket but not tennis? (Each member plays either Tennis or Cricket).

- (1) 15 (2) 20
(3) 30 (4) 40

31. $f: A \rightarrow B$ defined by $f(x) = 2x + 3$ and if $A = \{-2, -1, 0, 1, 2\}$, $B = \{-1, 1, 3, 5, 7\}$, then which type of function is f?

- (1) One-one (2) Onto
(3) Bijection (4) Constant

32. Write the properties that the relation “is greater than” satisfies in the set of all positive integers.

- (1) Reflexive (2) Symmetric
(3) Antisymmetric (4) Transitive

33. If $f = \{(1, 3), (2, 1), (3, 4), (4, 2)\}$ and $g = \{(1, 2), (2, 3), (3, 4), (4, 1)\}$, then find $n(\text{fog})$.

- (1) 12 (2) 16
(3) 4 (4) 5

34. If $f(x) = 2x + 1$ and $g(x) = 3x - 5$, then find $(\text{fog})^{-1}(0)$.

- (1) 5/3 (2) 3/2
(3) 2/3 (4) 3/5

35. The domain of the function $f(x) = \frac{1}{x+1}$ is $\underline{\hspace{2cm}}$.

- (1) R (2) $R - \{-1\}$
(3) $R - \{1\}$ (4) $R - \{0\}$

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 20: Select the correct alternative from the given choices.

1. If $A = \{a, b, c, d, e\}$, $B = \{a, c, e, g\}$ and $C = \{b, d, e, g\}$, then which of the following is true?
 - (1) $C \subset (A \cup B)$
 - (2) $C \subset (A \cap B)$
 - (3) $A \cup B = A \cup C$
 - (4) Both (1) and (3)
2. If $(2x - y, x + y) = (1, 11)$, then the values of x and y respectively are
 - (1) 6, 5
 - (2) 7, 4
 - (3) 4, 7
 - (4) 7, 3
3. If $n(P \times Q) = 0$, then $n(P)$ can possibly be
 - (1) 0
 - (2) 10
 - (3) 20
 - (4) All of these
4. The relation $R = \{(1, 1), (2, 2), (3, 3), (2, 3), (3, 2)\}$ in the set $A = \{1, 2, 3, 4\}$ is _____.
 - (1) reflexive
 - (2) symmetric
 - (3) anti-symmetric
 - (4) equivalence
5. The relation 'is a factor of' on the set of natural numbers is not _____.
 - (1) reflexive
 - (2) symmetric
 - (3) anti symmetric
 - (4) transitive
6. A relation between two persons is defined as R b 'if a and b born in different months', R is
 - (1) reflexive
 - (2) symmetric
 - (3) transitive
 - (4) equivalence
7. On the set of human beings a relation R is defined as follows:
 $a R b$ if a and b have the same brother, then R is
 - (1) only reflexive
 - (2) only symmetric
 - (3) only transitive
 - (4) equivalence
8. The range of the function $f(x) = x - [x]$ where $[x]$ represents the greatest integer less than or equal to x is _____.
 - (1) $\{0\}$
 - (2) $[0, 1]$
 - (3) $(0, 1)$
 - (4) $[0, 1)$
9. The function $f(x) = 0$ is
 - (1) an even function.
 - (2) an odd function.
 - (3) both(1) and (2).
 - (4) None of these
10. In the $x - y$ plane, the equation $y = 2k^2 - 1$ where k takes different values represents
 - (1) a parabola.
 - (2) a set of horizontal lines.
 - (3) a set of vertical lines.
 - (4) None of these
11. If A is a non-empty set, then $((A')')'$ is _____.
 - (1) A
 - (2) A^1
 - (3) μ
 - (4) ϕ
12. The number of non-empty proper subsets of a set A is 0, then $n(A) =$ _____.
 - (1) 0
 - (2) 1
 - (3) 2
 - (4) 3
13. If A and B are disjoint sets, then $A \Delta B =$ _____.
 - (1) $A \cup B$
 - (2) $A \cap B$
 - (3) $A - B$
 - (4) $B - A$
14. If $R = \{(x, y)/3x + 2y = 15 \text{ and } x, y \in \mathbb{N}\}$, the range of the relation R is _____.
 - (1) $\{1, 2\}$
 - (2) $\{1, 2, \dots, 5\}$
 - (3) $\{1, 2, \dots, 7\}$
 - (4) $\{3, 6\}$
15. $n(P \times Q) = 200$ and $n(P) = 100$, then $n(Q) =$ _____.
 - (1) 200
 - (2) 100
 - (3) 2
 - (4) None of these
16. If $a R b$, $b R c$ and $a R c$, and $a, b, c, \in A$, then the relation R on set A is said to be a/an _____ relation.
 - (1) reflexive
 - (2) symmetric
 - (3) transitive
 - (4) equivalence
17. f is a function from set A to set B . Then A is called _____.
 - (1) Domain
 - (2) Co-domain
 - (3) Range
 - (4) None of these
18. If $f(A)$ is a proper subset of B , then $f: A \rightarrow B$ is called a/an _____ function.
 - (1) into
 - (2) onto
 - (3) one-one
 - (4) identity
19. If f is a constant function and $f(100) = 100$, then $f(2007) =$ _____.
 - (1) 2007
 - (2) 100
 - (3) 0
 - (4) None of these

20. The number of elements of an identity function defined on a set containing four elements is ____.

(1) 2^2 (2) 2^4
(3) 2^8 (4) 2^{16}

Directions for questions 23 and 24: These questions are based on the following data.

A and B are two finite sets. The difference of the number of elements of the power sets is 96. (Assume $n(A) > n(B)$)

21. Find $n(A) + n(B)$.

(1) 11 (2) 12
(3) 13 (4) 14

22. Find $n(A) - n(B)$.

(1) 2 (2) 3
(3) 4 (4) 5

Directions for questions 24 and 25: These questions are based on the following data.

The relation R is defined on a set $P = \{a, b, c, d, e\}$ and R is a reflexive relation.

23. Which of the following is true about the number of elements of R?

(1) $1 \leq n(R) \leq 5$ (2) $1 \leq n(R) \leq 2^5$
(3) $5 \leq n(R) < 2^5$ (4) $5 \leq n(R) \leq 25$

24. How many reflexive relations are possible on P?

(1) 2^5 (2) 2^{25}
(3) 2^{20} (4) 2^{18}

Directions for questions 25 to 35: Select the correct alternative from the given choices.

25. If $M \cup N = N \cup R$ and $M \cap N = N \cap R$, then which of the following is necessarily true?

(1) $M = N$
(2) $N = R$
(3) $M = R$
(4) $M = N = R$

26. Find the domain of function, $\sum_{p=1}^{10} \frac{1}{|2x-p|}$.

(1) R
(2) $R - \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \dots, 10 \right\}$
(3) $R - \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \dots, 5 \right\}$
(4) $R - \{1, 2, \dots, 10\}$

27. $X \cap Y^c =$ ____

(1) $X \cup Y$
(2) $X - Y$
(3) $X \cap Y$
(4) $X \Delta Y$

28. If $f: R \rightarrow R$ defined by $f(x) = 2x^2 - 3x + 5$, then find the value of $\frac{f(x+h) - f(x)}{h}$ at $h \neq 0$.

(1) $4x + 2h$
(2) $4x + 2h - 3$
(3) $4x - 2h + 3$
(4) $4x - 2h - 3$

29. If $f(x) = 2x - 1$ and $g(x) = 3x + 2$, then find $(f \circ g)(x)$.

(1) $2(3x + 1)$
(2) $2(3x + 2)$
(3) $3(2x + 1)$
(4) $3(3x + 1)$

30. Find the domain of the function, defined by

$$f(x) = \frac{2}{3x^2 + 1}$$

(1) $R - \{1\}$ (2) R
(3) $R - \{-1\}$ (4) $R - \{0\}$

31. If $f(x) = x + 5$ and $g(x) = \sqrt{x^2 - 9}$, then find the domain of $\text{gof}(x)$.

(1) $(-8, -2)$
(2) $(-\infty, -8) \cup (-2, \infty)$
(3) $(-\infty, -8] \cup [-2, \infty)$
(4) $(-\infty, -8] \cup [-2, \infty)$

32. In a colony of 125 members, 70 members watch Telugu channel, 80 members watch Hindi channel and 95 watch English channel, 20 watch only Telugu and Hindi, 35 watch only English and Hindi and 15 watch only Telugu and English. How many members watch all the three channels, if each watches either of the channels?

(1) 25 (2) 20
(3) 30 (4) 35

33. If $f(a) = \left(\frac{1+a}{1-a} \right)$, then $f\left(\frac{a_1 + a_2}{1 + a_1 a_2} \right) =$

(1) $\left(\frac{f(a_1)}{f(a_2)} \right)$ (2) $f(a_1) + f(a_2)$
(3) $f(a_1) - f(a_2)$ (4) $f(a_1) \times f(a_2)$

34. The domain of the function $f(x) = \sqrt{x+2}$ is given by _____.

- (1) $x > 2$ (2) $x > -2$
 (3) $x \geq -2$ (4) $x \geq 2$

35. The function $f(x) = \frac{1}{|x+3|}$ is not defined for $x =$

- (1) 3 (2) -3
 (3) 0 (4) -2

ANSWERKEYS

PRACTICE EXERCISE 7 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 4 | 3. 3 | 4. 4 | 5. 1 | 6. 2 | 7. 4 | 8. 2 | 9. 2 | 10. 3 |
| 11. 4 | 12. 3 | 13. 2 | 14. 2 | 15. 2 | 16. 3 | 17. 2 | 18. 3 | 19. 1 | 20. 3 |
| 21. 4 | 22. 3 | 23. 2 | 24. 1 | 25. 4 | 26. 2 | 27. 4 | 28. 1 | 29. 2 | 30. 1 |
| 31. 3 | 32. 4 | 33. 3 | 34. 2 | 35. 2 | | | | | |

PRACTICE EXERCISE 7 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 4 | 4. 2 | 5. 2 | 6. 2 | 7. 4 | 8. 4 | 9. 3 | 10. 2 |
| 11. 1 | 12. 2 | 13. 1 | 14. 4 | 15. 3 | 16. 3 | 17. 1 | 18. 1 | 19. 2 | 20. 1 |
| 21. 2 | 22. 1 | 23. 4 | 24. 3 | 25. 3 | 26. 3 | 27. 2 | 28. 2 | 29. 3 | 30. 2 |
| 31. 3 | 32. 1 | 33. 4 | 34. 3 | 35. 2 | | | | | |

Limits and Matrices

SYNOPSIS

Limits

The following are some simple algebraic rules of limits.

- (i) $\lim_{x \rightarrow a} k f(x) = k \lim_{x \rightarrow a} f(x)$
- (ii) $\lim_{x \rightarrow a} [f(x) \pm g(x)] = \lim_{x \rightarrow a} f(x) \pm \lim_{x \rightarrow a} g(x)$
- (iii) $\lim_{x \rightarrow a} [f(x) \cdot g(x)] = \lim_{x \rightarrow a} f(x) \cdot \lim_{x \rightarrow a} g(x)$
- (iv) $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{\lim_{x \rightarrow a} f(x)}{\lim_{x \rightarrow a} g(x)}$ (where $\lim_{x \rightarrow a} g(x) \neq 0$)

Note:

1. If the left hand limit of a function is not equal to the right hand limit of the function, then the limit does not exist.
 2. A limit equal to infinity does not imply that the limit does not exist.
- $\lim_{x \rightarrow a} \left[\frac{x^n - a^n}{x - a} \right] = na^{n-1}$ (where 'n' is any rational number)
 - **Matrix:** A matrix is a rectangular arrangement of a set of elements in the form of horizontal and vertical lines.
 - **Order of a matrix:** If a matrix A has "m" rows and "n" columns, then $m \times n$ is called the order (or type) of matrix, and is denoted as $A_{m \times n}$.

- **Identity matrix (or) unit matrix:** In a square matrix, if all the principal diagonal elements are unity and rest of the elements are zeroes, then the square matrix is called identity matrix or unit matrix.
- **Principal diagonal of a square matrix:** In a square matrix A of order n, the elements a_{ii} (i.e., $a_{11}, a_{22}, \dots, a_{nn}$) constitute principal diagonal. The elements a_{ii} are called elements of principal diagonal.
- **Trace of a matrix:** In a square matrix sum of the principal diagonal elements is called Trace of the given Matrix.

Matrix Addition

- (1) Matrix addition is commutative i.e., if A and B are two matrices of same order, then $A + B = B + A$
- (2) Matrix addition is associative, i.e., if A, B and C are three matrices of same order, then $A + (B + C) = (A + B) + C$.
- (3) Additive identity:
If $O_{m \times n}$ is a null matrix of order $m \times n$ and A is any matrix of order $m \times n$, then $A + O = O + A = A$
So, O is called additive identity.
- (4) Additive inverse:
If $A_{m \times n}$ is any matrix of order $m \times n$, then $A + (-A) = (-A) + A = O$
So, -A is called additive inverse of the matrix A.
- (5) If k is a scalar and A and B are two matrices of same order, then $k(A+B) = kA + kB$

Matrix Subtraction

- (1) Matrix subtraction is possible only when both the matrices are of same order.
 - (2) The difference of two matrices of same type (or order) A and B i.e., $A - B$, is obtained by subtracting corresponding element of B from that of A.
 - (3) The difference matrix is of the same order as that of A or B.
- **Transpose of a matrix:** For a given matrix A, the matrix obtained by interchanging its rows and columns is called transpose of the matrix A and is denoted by A^T .
 - **Symmetric matrix:** A Square matrix is said to be symmetric if the transpose of the given matrix is equal to the matrix itself. Hence a Square matrix A is symmetric $\Rightarrow A = A^T$
 - **Skew-Symmetric matrix:** A Square matrix A is said to be Skew-symmetric if $A^T = -A$, i.e., transpose of the matrix is equal to its additive inverse.
 - **Multiplication of matrices:** Two matrices A and B can be multiplied only if the number of columns in A is equal to the number of rows in B.

Suppose order of matrix A is $m \times q$. Then order of matrix B, such that AB exists, should be of the form $q \times n$. Further order of the product matrix AB will be $m \times n$.

In general (i, j)th element of AB = sum of products of elements of i^{th} row in A with the corresponding elements of j^{th} column in B.

- **Determinant:** For a given 2×2 square matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, the real number $(ad - bc)$ is defined as the determinant of A and is denoted by $|A|$.
- **Singular matrix:** If the determinant of a Square matrix is zero, then the matrix is called a Singular matrix.
- **Non-singular matrix:** If the determinant of a square matrix is not equal to zero, then the matrix is called Non-singular matrix.
- **Multiplicative inverse of a square matrix:** For every Non-singular Square matrix A of order n, there exists a non-singular square matrix B of same order, such that $AB = BA = I$. (Note that I is unit matrix of order n). Here B is called multiplicative inverse of A and is denoted as $A^{-1} \Rightarrow B = A^{-1}$.
Note: If $AB = KI$, then $A^{-1} = \frac{1}{k} B$.

Note:

1. For a singular square matrix $|A| = 0$, and so its multiplicative inverse doesn't exist. Conversely, if a matrix A doesn't have multiplicative inverse, then $|A| = 0$.
 2. If A is a square matrix and K is any scalar, then $(KA)^{-1} = \frac{1}{K} A^{-1}$.
 3. For any two square matrices A and B of same order $(AB)^{-1} = B^{-1} A^{-1}$.
- **Inverse of a 2×2 square matrix:** $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, $A^{-1} = \frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

Solved Examples

1. Evaluate: $\lim_{x \rightarrow a} \frac{x^{14} - a^{14}}{x^{-7} - a^{-7}}$

☞ **Solution:** $\lim_{x \rightarrow a} \frac{x^{14} - a^{14}}{x^{-7} - a^{-7}}$

We know that

$$\lim_{x \rightarrow a} \frac{x^m - a^m}{x^n - a^n} = \left(\frac{m}{n}\right) a^{m-n}$$

$$\begin{aligned} \Rightarrow \lim_{x \rightarrow a} \frac{x^{14} - a^{14}}{x^{-7} - a^{-7}} &= \frac{14}{-7} (a^{14 - (-7)}) \\ &= -2a^{21}. \end{aligned}$$

2. Evaluate: $\lim_{x \rightarrow \infty} \frac{4x-3}{2x+3}$

☞ **Solution:** $\lim_{x \rightarrow \infty} \frac{4x-3}{2x+3} = \lim_{x \rightarrow \infty} \frac{(4-3/x)x}{(2+3/x)x}$

$$\left[\text{when } x \rightarrow \infty, \frac{1}{x} \rightarrow 0 \right]$$

$$= \frac{(4-0)}{(2+0)} = 2.$$

3. Evaluate: $\lim_{x \rightarrow 2} \frac{x-2}{\sqrt{x+2}-2}$

☞ **Solution:** $\lim_{x \rightarrow 2} \frac{x-2}{\sqrt{x+2}-2}$, Rationalizing the denominator, we get

$$\begin{aligned} &= \lim_{x \rightarrow 2} \frac{(x-2)(\sqrt{x+2}+2)}{(\sqrt{x+2}-2)(\sqrt{x+2}+2)} \\ &= \lim_{x \rightarrow 2} \frac{(x-2)(\sqrt{x+2}+2)}{(x+2)-4} = \lim_{x \rightarrow 2} \frac{(x-2)(\sqrt{x+2}+2)}{(x-2)} \\ &= \sqrt{2+2}+2 = 4. \end{aligned}$$

4. Evaluate: $\lim_{n \rightarrow \infty} \frac{1}{2^n}$.

☞ **Solution:** As $n \rightarrow \infty$,
 $a^n \rightarrow 0$ where $0 < a < 1$.

$$\therefore \lim_{n \rightarrow \infty} \frac{1}{2^n} = \left(\frac{1}{2}\right)^n = 0$$

5. Evaluate: $\lim_{x \rightarrow 3} \frac{|x-3|}{x-3}$.

☞ **Solution:** As $x \rightarrow 3^-$, $x-3 < 0$

$$\therefore |x-3| = -(x-3)$$

$$\therefore \lim_{x \rightarrow 3^-} \frac{|x-3|}{x-3} = \lim_{x \rightarrow 3^-} \frac{-(x-3)}{x-3} = -1$$

As $x \rightarrow 3^+$, $(x-3) > 0 \therefore |x-3| = x-3$

$$\lim_{x \rightarrow 3^+} \frac{|x-3|}{x-3} = \lim_{x \rightarrow 3^+} \frac{x-3}{x-3} = 1$$

Clearly \therefore L.H.S. \neq R.H.S

Hence the limit does not exist.

6. If $A = \begin{bmatrix} 2 & -3 \\ 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 3 \\ 5 & 0 \end{bmatrix}$ and $C = \begin{bmatrix} -1 & 2 \\ 0 & 5 \end{bmatrix}$,

then find $A(B+C)$.

☞ **Solution:** $B+C = \begin{bmatrix} 2 & 3 \\ 5 & 0 \end{bmatrix} + \begin{bmatrix} -1 & 2 \\ 0 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 5 \\ 5 & 5 \end{bmatrix}$

$$A(B+C) = \begin{bmatrix} 2 & -3 \\ 4 & 1 \end{bmatrix} \begin{bmatrix} 1 & 5 \\ 5 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 2-15 & 10-15 \\ 4+5 & 20+5 \end{bmatrix} \cdot A(B+C)$$

$$= \begin{bmatrix} -13 & -5 \\ 9 & 25 \end{bmatrix}$$

7. Find the inverse of the matrix $A = \begin{bmatrix} 2 & -4 \\ 3 & -5 \end{bmatrix}$.

☞ **Solution:** $|A| = \begin{vmatrix} 2 & -4 \\ 3 & -5 \end{vmatrix} = -10 + 12 = 2 \neq 0$.

$$\therefore A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} = \frac{1}{2} \begin{bmatrix} -5 & 4 \\ -3 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{-5}{2} & 2 \\ \frac{-3}{2} & 1 \end{bmatrix}$$

8. If $\begin{bmatrix} -3 & 2x-5 \\ 4 & 1 \end{bmatrix}$ is a singular matrix, then find x .

☞ **Solution:** Given, $\begin{vmatrix} -3 & 2x-5 \\ 4 & 1 \end{vmatrix} = 0$.

$$\Rightarrow -3(1) - 4(2x-5) = 0 \Rightarrow -3 - 8x + 20 = 0$$

$$\Rightarrow -8x + 17 = 0 \Rightarrow x = 17/8.$$

9. If $|A| = 47$, then find $|A^T|$.

☞ **Solution:** Given that $|A| = 47$.

We know that, $|A| = |A^T|$

$$\therefore |A^T| = 47$$

10. If $A = \begin{pmatrix} 2 & 5a \\ -3 & 1 \end{pmatrix}$ and A doesn't have multiplicative inverse, then find a .

☞ **Solution:** $\therefore |A| = 0 \Rightarrow \begin{vmatrix} 2 & 5a \\ -3 & 1 \end{vmatrix} = 0$

$$= 2 \times 1 - 5a(-3) = 0$$

$$\Rightarrow 2 + 15a = 0$$

$$\Rightarrow 15a = -2$$

$$\Rightarrow a = -2/15$$

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. $\lim_{x \rightarrow \infty} \frac{4x-3}{(2x+3)} = \underline{\hspace{2cm}}$.

- (1) 0 (2) 1
(3) $\frac{1}{2}$ (4) 2

2. $\lim_{x \rightarrow 1} \frac{(x-5)(x+7)}{(x+2)(5x+1)} = \underline{\hspace{2cm}}$.

- (1) $-\frac{1}{5}$ (2) 2
(3) 5 (4) $-\frac{16}{9}$

3. Evaluate: $\lim_{x \rightarrow 20} \frac{\sqrt{x+5}+5}{\sqrt{x+5}-5}$

- (1) 1 (2) 2
(3) 4 (4) ∞

4. $\lim_{x \rightarrow 3} x^3 - 3x^2 + x - 3 = \underline{\hspace{2cm}}$.

- (1) 27 (2) 9
(3) 3 (4) 0

5. $\lim_{x \rightarrow 1/3} 9x^2 + 6x + 1 = \underline{\hspace{2cm}}$

- (1) 2 (2) $1/4$
(3) $1/2$ (4) 4

6. Evaluate: $\lim_{x \rightarrow 3} (4x^2 + 3)$

- (1) 36 (2) 39
(3) 40 (4) None of these

7. $\lim_{x \rightarrow 0} \frac{\sqrt{2-3x}\sqrt{2+3x}}{\sqrt{x+2}} = \underline{\hspace{2cm}}$

- (1) $\sqrt{2}$ (2) 2
(3) $2\sqrt{2}$ (4) 4

8. Evaluate $\lim_{x \rightarrow 1} \frac{f(x)-f(1)}{x-1}$, where $f(x) = x^2 - 2x$.

- (1) -1 (2) 0
(3) 1 (4) 2

9. $\lim_{x \rightarrow \infty} \frac{6x^4 + 7x^3 + 2x + 1}{x^4 + 1} = \underline{\hspace{2cm}}$.

- (1) 1 (2) 2
(3) 3 (4) 6

10. $\lim_{x \rightarrow \frac{\pi}{2}} \frac{1 - \sin x}{x} = \underline{\hspace{2cm}}$.

- (1) ∞ (2) -1
(3) 1 (4) 0

11. $\lim_{x \rightarrow 4^-} \frac{|x-4|}{x-4} = \underline{\hspace{2cm}}$

- (1) -1 (2) 0
(3) 1 (4) 2

12. $\lim_{x \rightarrow 0} \frac{(x+2)^{10} - 2^{10}}{(x+2)^5 - 2^5}$ is $\underline{\hspace{2cm}}$

- (1) 16 (2) 32
(3) 64 (4) 128

13. Evaluate: $\lim_{n \rightarrow \infty} \frac{1+3+5+\dots n \text{ terms}}{2+4+6+\dots n \text{ terms}}$.

- (1) 2 (2) 1
(3) 3 (4) ∞

14. Evaluate: $\lim_{n \rightarrow \infty} \frac{\sum n^2}{n^3}$

- (1) $1/2$ (2) $1/4$
(3) $1/3$ (4) ∞

15. $\lim_{x \rightarrow \infty} \frac{(x+1)^{100} + (x+2)^{100} + \dots + (x+50)^{100}}{x^{100} + x^{99} + \dots + x + 1} = \underline{\hspace{2cm}}$.

- (1) 100 (2) 1
(3) 21 (4) 50

16. $\lim_{x \rightarrow a} (x-a) \left(\frac{1}{x-a} - \frac{1}{x^2 - (a+b)x + ab} \right) = \underline{\hspace{2cm}}$.

- (1) $\frac{a-b-1}{a-b}$ (2) 0
(3) 1 (4) $\frac{a+b}{a-b}$

17. $\lim_{x \rightarrow \frac{2}{5}} \frac{1}{|5x-2|} = \underline{\hspace{2cm}}$.

- (1) 0 (2) ∞
(3) 1 (4) Does not exist

18. If $\lim_{x \rightarrow m} \frac{x^3 - m^3}{x - m} = 3$, then find the number of possible values of m .

- (1) 0 (2) 2
(3) 1 (4) 3

19. If $A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & x & 0 \\ 0 & 0 & m \end{bmatrix}$ is a scalar matrix, then $x + m =$
- (1) 0 (2) -1
(3) -2 (4) -3
20. If $\begin{bmatrix} 4 & -3 \\ 2 & 16 \end{bmatrix} = \begin{bmatrix} 4 & -3 \\ 2 & 2^t \end{bmatrix}$, then $t =$ ____.
- (1) 2 (2) 3
(3) 4 (4) 5
21. If $a_{ij} = 0$ ($i \neq j$) and $a_{ij} = 1$ ($i = j$), then the matrix $A = [a_{ij}]_{n \times n}$ is a ____ matrix.
- (1) Null
(2) Unit
(3) Scalar
(4) Diagonal
22. If a matrix P has 8 elements, then how many different values, the order of the matrix can take?
- (1) 3 (2) 4
(3) 8 (4) 6
23. If $A = [a_{ij}]_{2 \times 2}$ such that $a_{ij} = i - j + 3$, then find A .
- (1) $\begin{bmatrix} 2 & 3 \\ 4 & 2 \end{bmatrix}$ (2) $\begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$
(3) $\begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & 2 \\ 4 & 3 \end{bmatrix}$
24. If $(A + B^T)^T$ is a matrix of order 4×3 , then the order of matrix B is ____.
- (1) 3×4 (2) 4×3
(3) 3×3 (4) 4×4
25. If A is any square matrix, then $\frac{1}{2}(A - A^T)$ is a ____ matrix.
- (1) Identity (2) Scalar
(3) Symmetric (4) Skew symmetric
26. If $A = \begin{bmatrix} -3 & 5 \\ 5 & 0 \\ -7 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & -5 & 7 \\ -5 & 0 & -4 \end{bmatrix}$, then find $A + B^T$.
- (1) O (2) $2B$
(3) $2A^T$ (4) $2B^T$
27. $M \times \begin{pmatrix} 1 & 2 \\ 0 & 5 \end{pmatrix} \begin{pmatrix} 2 & 3 & 0 \\ 4 & -2 & 1 \end{pmatrix}$ is a square matrix, then the order of M is ____.
- (1) 2×3 (2) 1×2
(3) 3×2 (4) 2×2
28. If the order of matrices A and B are 3×2 and 2×1 respectively, then find the order of matrix (if possible) AB .
- (1) 1×3 (2) 3×1
(3) 2×2 (4) 2×3
29. If $A + B^T = \begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$ and $A^T - B = \begin{bmatrix} 7 & 8 \\ -1 & 3 \end{bmatrix}$, then find matrix A .
- (1) $\begin{bmatrix} 4 & 1 \\ 6 & 4 \end{bmatrix}$
(2) $\begin{bmatrix} -3 & -2 \\ 2 & 1 \end{bmatrix}$
(3) $\begin{bmatrix} 4 & 6 \\ 1 & 4 \end{bmatrix}$
(4) $\begin{bmatrix} -3 & 2 \\ -2 & 1 \end{bmatrix}$
30. If $A = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 1 & 2 \\ 0 & 2 & -1 \end{bmatrix}$, then find $(AB^T)^T$.
- (1) $\begin{bmatrix} 2 & -5 \\ 1 & 6 \end{bmatrix}$ (2) $\begin{bmatrix} 3 & -4 \\ 7 & -6 \end{bmatrix}$
(3) $\begin{bmatrix} -4 & 9 \\ -2 & 1 \end{bmatrix}$ (4) $\begin{bmatrix} -3 & 8 \\ 4 & 2 \end{bmatrix}$
31. If $A = \begin{pmatrix} 2 & 3 \\ 5 & 1 \end{pmatrix}$, $B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and $AB = -13I$, then find the value of $a + b - c + d$.
- (1) 2 (2) 3
(3) 4 (4) 5
32. If $A_{2 \times 3}$, $B_{4 \times 3}$ and $C_{2 \times 4}$ are three matrices, then which of the following is/are defined?
- (1) AC^TB
(2) B^TC^TA
(3) AB^TC
(4) All of these

33. If $A = \begin{bmatrix} a & b & c \\ x & y & z \\ \ell & m & n \end{bmatrix}$ is a skew-symmetric matrix, then

which of the following is equal to $x + y + z$?

- (1) $a + b + c$
 (2) $l + m + n$
 (3) $a - b - m$
 (4) $c - l - n$

34. If $AB = kI$, where $k \in \mathbb{R}$, then $A^{-1} = \underline{\hspace{2cm}}$.

- (1) B (2) KB
 (3) $\frac{1}{K}B$ (4) $\frac{1}{K^2}B$

35. If $\begin{vmatrix} 2 & -4 \\ 9 & d-3 \end{vmatrix} = 4$, then $d = \underline{\hspace{2cm}}$.

- (1) 10 (2) -11
 (3) 12 (4) -13

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Evaluate: $\lim_{x \rightarrow 1} \frac{2x^2 + 4x + 4}{2x - 1}$

- (1) 1 (2) 10
 (3) 20 (4) 5

2. $\lim_{x \rightarrow 0} \frac{\sqrt{8-3x} + \sqrt{8+4x}}{\sqrt{2-3x}} = \underline{\hspace{2cm}}$.

- (1) 5 (2) 3
 (3) 2 (4) 4

3. Evaluate, $\lim_{x \rightarrow 2} \frac{f(x) - f(2)}{x - 2}$, where $f(x) = x^2 - 4x$.

- (1) -1 (2) 2
 (3) 0 (4) 4

4. $\lim_{x \rightarrow \infty} \frac{(4x+5)(2x-1)}{(27x^2+1)} = \underline{\hspace{2cm}}$.

- (1) $\frac{4}{27}$ (2) $\frac{8}{27}$
 (3) $\frac{2}{27}$ (4) $\frac{6}{27}$

5. $\lim_{x \rightarrow \infty} \frac{7x^2 - 5x + 6}{x^2 + x + 1} = \underline{\hspace{2cm}}$.

- (1) 7 (2) 0
 (3) ∞ (4) 1

6. $\lim_{x \rightarrow \infty} \frac{2x+4}{x-2} = \underline{\hspace{2cm}}$.

- (1) 1 (2) 0
 (3) 2 (4) 6

7. $\lim_{x \rightarrow \infty} \frac{x^3 + x^2 + 1}{2x^2 + 3x + 4} =$

- (1) 0 (2) 1
 (3) ∞ (4) -1

8. $\lim_{x \rightarrow 3} \frac{\sqrt{x+13} + \sqrt{x+6}}{\sqrt{x+1} + 2} = \underline{\hspace{2cm}}$.

- (1) 1 (2) 7
 (3) $1/4$ (4) $7/4$

9. $\lim_{x \rightarrow -1} \frac{x^2 + 1}{x - 1} = \underline{\hspace{2cm}}$.

- (1) 0 (2) 1
 (3) -1 (4) -2

10. $\lim_{x \rightarrow 1} \frac{3x^5 + 5x^{10} - 7x^{15}}{11x^{15} - 13x^9 + 17x^4} =$

- (1) $3/11$ (2) $3/17$
 (3) $1/15$ (4) $1/11$

11. $\lim_{x \rightarrow 0} \frac{\sqrt{16+x} - 4}{x}$ is $\underline{\hspace{2cm}}$

- (1) 4 (2) 8
 (3) $1/4$ (4) $1/8$

12. Evaluate: $\lim_{\theta \rightarrow 0} \cot \theta - \operatorname{cosec} \theta$

- (1) 0 (2) 2
 (3) 4 (4) None of these

13. $\lim_{x \rightarrow 3^-} \frac{|2x-6|}{2x-6}$ is $\underline{\hspace{2cm}}$.

- (1) 1 (2) -1
 (3) 0 (4) ∞

14. If $\lim_{x \rightarrow -2} \frac{x^p + 2^p}{x + 2} = 80$ (where p is an odd number), then p can be ____.

(1) 3 (2) 5
(3) 7 (4) 9

15. Evaluate: $\lim_{x \rightarrow 0} \frac{\sin x + \cos x}{\sin x - \cos x}$.

(1) 0 (2) 1
(3) -1 (4) ∞

16. $\lim_{x \rightarrow \infty} \frac{5x^2}{\sqrt{25x^4 + 13x^3 + 14x^2 + 17x + 6}}$ is ____.

(1) 1 (2) 1/5
(3) 5/14 (4) None of these

17. $\lim_{x \rightarrow -1} \frac{x^5 + 1}{x + 1} =$ ____.

(1) 1 (2) -5
(3) 5 (4) None of these

18. Evaluate: $\lim_{n \rightarrow \infty} \frac{3^n - 2^n}{3^n + 2^n}$

(1) 1 (2) 1/3
(3) 1/2 (4) ∞

19. If $a_{ij} = 0$ ($i \neq j$) and $a_{ij} = 2$ ($i = j$), then the matrix $A = [a_{ij}]_{n \times n}$ is a ____ matrix.

(1) unit (2) null
(3) scalar (4) skew symmetric

20. If the order of a matrix is 20×5 , then the number of elements in the matrix is ____.

(1) 5 (2) 20
(3) 50 (4) 100

21. A matrix has 16 elements. Which of the following can be the order of the matrix?

(1) 1×16 (2) 2×8
(3) 4×4 (4) All of these

22. A matrix has 18 elements. Find the number of possible orders of the matrix.

(1) 5 (2) 6
(3) 4 (4) 7

23. If A is any square matrix, then $(1/2)(A + A^T)$ is a ____ matrix.

(1) symmetric
(2) skew symmetric

(3) scalar
(4) identity

24. If $A \times \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 3 & 1 & 2 \end{bmatrix}$, then the order of A is ____.

(1) 2×3 (2) 3×3
(3) 3×2 (4) 2×2

25. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -3 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 4 & -2 \\ 1 & 0 & 0 \end{bmatrix}$, then the order of AB^T is ____.

(1) 2×3 (2) 3×3
(3) 3×2 (4) 2×2

26. If $AB^T = \begin{bmatrix} 1 & 2 & 0 \\ 3 & 2 & 0 \end{bmatrix}$ and A has only one column, then B has ____ column(s).

(1) 1 (2) 2
(3) 3 (4) Can't say

27. What is the condition that is to be satisfied for the identity $(P + Q)(P - Q) = P^2 - Q^2$ to be true for any two square matrices P and Q ?

(1) The identity is always true.
(2) $PQ \neq QP$.
(3) PQ and QP are not null matrices.
(4) $PQ = QP$

28. If $A = \begin{bmatrix} 2 & -5 \\ 0 & 1 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then find the matrix X such that $4A - 2X + I = O$.

(1) $\begin{bmatrix} 0 & 1/2 \\ -5 & 9/2 \end{bmatrix}$ (2) $\begin{bmatrix} 9/2 & -1 \\ -8 & 3/2 \end{bmatrix}$
(3) $\begin{bmatrix} 9/2 & -10 \\ 0 & 5/2 \end{bmatrix}$ (4) $\begin{bmatrix} 5/2 & -6 \\ 1 & 3/12 \end{bmatrix}$

29. If $(13) \begin{pmatrix} 2x-1 & 6 \\ 9 & 7 \end{pmatrix} = (32p)$, then find the value of $p + x$.

(1) 30 (2) 27
(3) 35 (4) 29

30. If $A = \begin{pmatrix} 2 & 0 \\ 5 & -3 \end{pmatrix}$, $B = \begin{pmatrix} -2 & 1 \\ 3 & -1 \end{pmatrix}$, then find the trace of $(AB^T)^T$.

- (1) 10 (2) 12
(3) 14 (4) 16

31. If A is a 2×3 matrix and B is 3×2 matrix, then the order of $(AB)^T$ is equal to the order of ____.

- (1) AB
(2) $A^T B^T$
(3) BA
(4) All of these

32. If $A = \begin{bmatrix} 2 & 4 \\ k & -2 \end{bmatrix}$, and $A^2 = O$, then find the value of k.

- (1) -4 (2) -3
(3) -2 (4) -1

33. $(AB)^{-1} = \underline{\hspace{1cm}}$.

- (1) BA (2) $A^{-1}B^{-1}$
(3) $B^{-1}A^{-1}$ (4) All of these

34. If $A = \begin{pmatrix} 2 & 3 \\ 6 & 9 \end{pmatrix}$, then $|A| = \underline{\hspace{1cm}}$.

- (1) 0 (2) 1
(3) 2 (4) 3

35. If $A = \begin{bmatrix} 5 & -3 \\ 4 & 2 \end{bmatrix}$, then find $A A^{-1}$.

- (1) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ (2) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$
(3) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (4) Does not exist

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 4 | 3. 4 | 4. 4 | 5. 4 | 6. 2 | 7. 1 | 8. 2 | 9. 4 | 10. 4 |
| 11. 1 | 12. 3 | 13. 2 | 14. 3 | 15. 4 | 16. 1 | 17. 2 | 18. 2 | 19. 3 | 20. 3 |
| 21. 2 | 22. 2 | 23. 4 | 24. 2 | 25. 4 | 26. 1 | 27. 3 | 28. 2 | 29. 1 | 30. 3 |
| 31. 4 | 32. 2 | 33. 3 | 34. 3 | 35. 4 | | | | | |

PRACTICE EXERCISE 8 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 3 | 4. 2 | 5. 1 | 6. 3 | 7. 3 | 8. 4 | 9. 3 | 10. 3 |
| 11. 4 | 12. 1 | 13. 2 | 14. 2 | 15. 3 | 16. 1 | 17. 3 | 18. 1 | 19. 3 | 20. 4 |
| 21. 4 | 22. 2 | 23. 1 | 24. 3 | 25. 4 | 26. 1 | 27. 4 | 28. 3 | 29. 1 | 30. 3 |
| 31. 1 | 32. 4 | 33. 3 | 34. 1 | 35. 3 | | | | | |

Statistics and Computing

SYNOPSIS

- **Arithmetic mean or Mean (A.M):** The arithmetic mean (or simply the mean) is the most commonly used measure of central tendency.

- (i) **For raw data:** The arithmetic mean of a statistical data is defined as the quotient obtained when the sum of all the observations or entries is divided by the total number of items.

$$\text{A.M. } x_1, x_2, \dots, x_n \text{ of} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum x}{n}$$

- (ii) **For discrete series:** Let $x_1, x_2, x_3 \dots x_n$ be n observations with respective frequencies $f_1, f_2, \dots f_n$. The observation x_1 occurs f_1 times; x_2 occurs f_2 times, and so on.

$$\text{A.M } (\bar{x}) = \frac{f_1 x_1 + f_2 x_2 + \dots + f_n x_n}{f_1 + f_2 + \dots + f_n} = \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i}$$

- (iii) **For grouped data:** If the frequency distribution of 'n' observations of a variable x has k classes, x_i is the midvalue and f_i is the frequency of i^{th} class, then the mean \bar{x} of grouped data is defined as

$$\bar{x} = \frac{f_1 x_1 + f_2 x_2 + \dots + f_k x_k}{f_1 + f_2 + \dots + f_k} = \frac{\sum_{i=1}^k f_i x_i}{\sum_{i=1}^k f_i} \quad (\text{or})$$

$$\text{simply, } \bar{x} = \frac{\sum f_i x_i}{N} \text{ where } N = \sum_{i=1}^k f_i.$$

In grouped data, it is assumed that the frequency of each class is concentrated at its mid-value.

Short-cut Method

$$\bar{x} = A + \frac{1}{N} \left(\sum_{i=1}^k f_i u_i \right) \times c \text{ where, } A = \text{assumed value from}$$

among mid-values;

C = length of class interval; K = number of classes of the frequency distribution;

$$N = \text{sum of frequencies} = \sum_{i=1}^k f_i; u_i = \frac{x_i - A}{C}, i = 1, 2, 3,$$

$\dots \dots k$ and x_i = mid-value of the i^{th} class.

Some Important Results about A.M.

1. The algebraic sum of deviations taken about the mean is zero. i.e., $\sum_{i=1}^n (x_i - \bar{x}) = 0$
2. The value of the mean depends on all the observations.
3. The A.M. of two numbers a and b is $\frac{a+b}{2}$.
4. Combined mean: If \bar{x}_1 and \bar{x}_2 are the arithmetic Means of two series with n_1 and n_2 observations

respectively, then the combined mean is: $\bar{x}_c = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$.

The above result can be extended to any number of groups of data.

5. If \bar{x} is the mean of x_1, x_2, \dots, x_n , then the mean of $x_1 + a, x_2 + a, x_3 + a, \dots, x_n + a$ is $\bar{x} + a$, for all values of a .

6. If \bar{x} is the mean of x_1, x_2, \dots, x_n , then the mean of ax_1, ax_2, \dots, ax_n is $a\bar{x}$ and that of $\frac{x_1}{a}, \frac{x_2}{a}, \dots, \frac{x_n}{a}$ is $\frac{\bar{x}}{a}$.

7. The mean of the first n natural numbers is $\left(\frac{n+1}{2}\right)$.

8. The mean of the squares of the first n natural numbers is $\frac{(n+1)(2n+1)}{6}$.

9. The mean of the cubes of the first n natural numbers is $\frac{n(n+1)^2}{4}$.

○ **Median:** If the values x_i in the raw data are arranged either in the increasing or decreasing order of magnitude, then the middle-most value in this arrangement is called the median.

Thus, for the raw (un-grouped) data, the median is computed as follows:

(i) The values of the observations are arranged in the order of magnitude.

(ii) The middle most value is taken as the median. Hence, depending on the number of observations (odd or even), we determine median as follows.

a. When the number of observations (n) is odd,

then the median is the value of $\left(\frac{n+1}{2}\right)^{\text{th}}$ observation.

b. If the number of observations (n) is even,

then the median is the mean of $\left(\frac{n}{2}\right)^{\text{th}}$ observation and $\left(\frac{n}{2} + 1\right)^{\text{th}}$ observation.

Median of Grouped Data

$$\text{Median (M)} = L + \frac{\left(\frac{n}{2} - F\right)}{f}(C)$$

Where, L = Lower boundary of median class i.e., class in which $(n/2)^{\text{th}}$ observation lies.

N = The sum of frequencies.

F = Cumulative frequency of the class just preceding the median class.

f = Frequency of median class.

C = Length of class interval.

Mode: The third measure of central tendency of a data is the mode.

Definition: The most frequently found value in the data is called the mode. This is the measure which can be identified in the simplest way.

Mode of grouped data: The formula for determining the mode of grouped data is $L_1 + \frac{\Delta_1 C}{\Delta_1 + \Delta_2}$.

Where L_1 = lower boundary of modal class (class with highest frequency).

$\Delta_1 = f - f_1$ and $\Delta_2 = f - f_2$ where f is the frequency of model class.

f_1 = frequency of previous class of the model class.

f_2 = frequency of next class of the model class.

$$\begin{aligned} \text{Rewriting the formula, Mode} &= L_1 + \frac{(f - f_1)C}{(f - f_1) + (f - f_2)} \\ &= L_1 + \frac{(f - f_1)C}{2f - (f_1 + f_2)}. \end{aligned}$$

Note:

1. For a given data, the mode may or may not exist. In a series of observations, if no item occurs more than once, then the mode is said to be ill-defined.
2. If the mode exists for a given data, it may or may not be unique.
3. Data having unique mode is uni-model while data having two modes is bi-model.

Properties of mode

1. It can be calculated graphically.
2. It is not effected by extreme values.
3. It can be used for open-ended distribution and qualitative data.

○ **Empirical relationship among mean, median and mode:** For a moderately symmetric data, the above three measures of central tendency can be related by the formula, $\text{Mode} = 3 \text{ Median} - 2 \text{ Mean}$

Observations

1. For a symmetric distribution, $\text{Mean} = \text{Median} = \text{Mode}$.
2. Given any two of the mean, median and mode the third can be calculated.

3. This formula is to be applied in the absence of sufficient data.
- **Range:** The difference between the maximum and the minimum values of the given observations is called the range of the data.

Variance and Standard Deviation

∴ Variance = (S.D.)² or S.D. = $\sqrt{\text{variance}}$

$$\text{S.D. } (\sigma) = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n}}$$

where x_1, x_2, \dots, x_n are n observations with mean as \bar{x} . Alternatively the above formula can also be written as

$$\text{S.D. } (\sigma) = \sqrt{\frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2}$$

Calculation of Variance and S.D. for a Grouped Data

- (1) $N = \sum f$ = The sum of the frequencies.
- (2) A.M. $(\bar{x}) = \frac{\sum fx}{N}$.
- (3) D = Deviation from the A.M. = $(x - \bar{x})$
- (4) Standard deviation (S.D.) = $\sigma = \sqrt{\frac{\sum fD^2}{N}}$.

Computing

- A set of instructions that are written in a language that can be understood by a computer is called a program. A set of programs is called a **software**.
- **Algorithm:** A comprehensive and detailed step-by-step plan or a design that is followed to solve a problem is called an algorithm. Thus, an algorithm is a set of systematic and sequential steps in arriving at a solution to a problem.
- **Flow chart:** Flow chart is the pictorial representation of an algorithm. Flow chart clearly depicts the points of input, decision-making, loops and output. Thus with the help of a flow chart we can plan more clearly and logically to solve a given task.
- **BASIC:** Basic (Beginners All purpose symbolic Instruction code) is a high level language and user friendly. The instructions can be given in simple English language along with some keywords and specific syntax. This language is useful in the field of Business, Engineering, Mathematics and other applications.

- **Constants:** Constants are those which do not change their values in the program. They can be classified as
 - (1) Numeric constants
 - (2) Alphanumeric constants
- **Numeric:** All whole numbers ranging from -32767 to $+32767$ are numeric constants.
- **Alphanumeric:** Set of alphabets or numerics or alphanumeric which are enclosed within double quotation marks are treated as alphanumeric or string constants.
E.g., "A", "576", "AP007"
- **Variables:** It is a name which represents a number, a character or a string.
Variables are of two types.

Rules for Declaration of Variables

- (1) Variable must start with an alphabet.
 - (2) Keywords should not be used as a variable name.
 - (3) In a variable name declaration, commas and blank spaces are not allowed.
 - (4) The variable length should not exceed 40 characters.
 - (5) The special characters like %, #, and \$ are not allowed in variables.
- **Basic Operators:** Operators are used to relate variables and constants to form expressions.
Operators are of three types:
Arithmetic operators, Logical operators, Relational operators
 - **BASIC statements:** BASIC statements are primarily of two types—executable and non executable. Executable statements are those which are executed by the computer, while non-executable statements are those which are ignored by the computer and used for the user to understand the nature of the program. The following statements are generally used in BASIC Programming.
 - (1) REM, (2) LET, (3) INPUT, (4) READ ... DATA, (5) END, (6) GOTO, (7) PRINT, (8) BRANCHING, (9) STOP
 - **Conditional statements:** The statements which are dependent on certain conditions are known as conditional statements. Only if the test of expression is true, the statements which are dependent on condition be executed. Otherwise, they will be skipped.
Conditional statements are of two types:
 - (1) Branching statements
 - (2) Looping statements

Solved Examples

1. Find the mean of the first 10 natural numbers.

☞ **Solution:** Given data is 1, 2, 3, ... 10
 \therefore Arithmetic mean (A.M)

$$= \frac{\text{The sum of observations}}{\text{The total number of observations}}$$

$$= \frac{1 + 2 + 3 + \dots + 10}{10} = \frac{55}{10} = 5.5$$

2. Find the median of the following data: 2, 7, 3, 15, 12, 17 and 5.

☞ **Solution:** Arranging the given numbers in the ascending order, we have 2, 3, 5, 7, 12, 15, 17. Here, middle term is 7. \therefore Median = 7.

3. Find the mode of 0, 5, 2, 7, 2, 1, 1, 3, 2, 4, 5, 7, 5, 1 and 2.

☞ **Solution:** Among the observations given, the most frequently found observation is 2. It occurs 4 times. \therefore Mode = 2.

4. Find the quartile deviation of 6, 12, 14, 16, 18, 20 and 24.

☞ **Solution:** The ascending order of the given observations is 6, 12, 14, 16, 18, 20, 24

$$Q_1 = \left(\frac{n+1}{4} \right)^{\text{th}} \text{ observation} = 2^{\text{nd}} \text{ observation} = 12$$

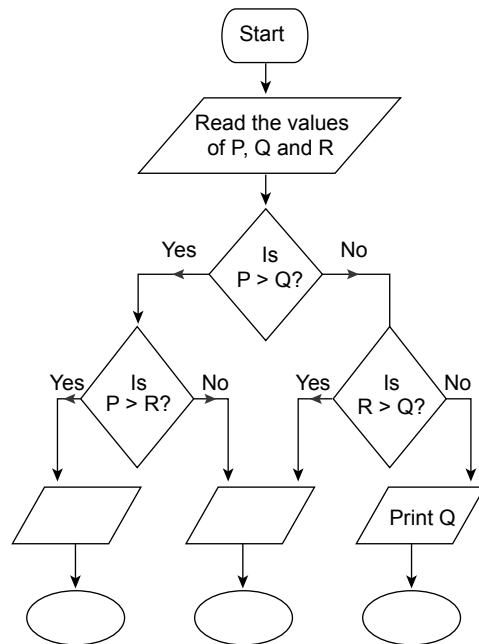
$$Q_3 = 3 \left(\frac{n+1}{4} \right)^{\text{th}} \text{ observation} = 6^{\text{th}} \text{ observation} = 20$$

$$Q.D = \frac{Q_3 - Q_1}{2} = \frac{20 - 12}{2} = 4$$

5. Write a program in BASIC to find the distance between two points using the INPUT keyword.

☞ **Solution:** 10 REM "Distance between two points"
 20 INPUT "Enter the values for x_1, y_1 and x_2, y_2 ", x_1, y_1, x_2, y_2 .
 30 LET Distance = $((x_1 - x_2)^2 + (y_1 - y_2)^2)^{1/2}$
 40 PRINT "Distance"; Distance; 50 END

6. If 12, 120 and 105 are the values of P, Q and R respectively, then what is the output of the following flow chart?



☞ **Solution:** This flow chart finds the largest value in the given three numbers i.e., 120.

PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The class mark of a class is 25 and if the upper limit of that class is 40, then its lower limit is _____.
 (1) 30 (2) 20
 (3) 15 (4) 10
2. If 1 – 5, 6 – 10, 11 – 15, are the classes of a frequency distribution, then the size of the class is _____.
 (1) 4 (2) 5
 (3) 3 (4) 2.5
3. Consider the data: 2, 3, 2, 4, 5, 6, 4, 2, 3, 3, 7, 8, 2, 2. The frequency of 2 is _____.
 (1) 4 (2) 5
 (3) 6 (4) 3
4. If 1 – 5, 6 – 10, 11 – 15, 16 – 20..... are the classes of a frequency distribution, then the lower boundary of the class 11 – 15 is _____.
 (1) 11 (2) 11.5
 (3) 10.5 (4) 10
5. In a table showing L.C.F.D. and G.C.F.D; for a class whose upper boundary is 60, has less than cumulative frequency of 35. And a class whose lower boundary is 60, has greater than cumulative frequency of 25. Find the total frequency of the distribution.
 (1) 10 (2) 60
 (3) 35 (4) 70
6. The sum of 12 observations is 600, then their mean is _____.
 (1) 30 (2) 40
 (3) 50 (4) 60
7. The mean of x, y, z is y , then $x + z =$ _____.
 (1) y (2) $3y$
 (3) $2y$ (4) $4y$
8. The mean of cubes of first 15 natural numbers is _____.
 (1) 980 (2) 960
 (3) 1920 (4) 1940
9. The median of first 16 prime numbers is _____.
 (1) 12 (2) 24
 (3) 21 (4) 30
10. If the mean of a set of 15 observations is 12 and that of another set of 10 observations is 15, then find the mean of combined set.
 (1) 15 (2) 14.1
 (3) 12.5 (4) 13.2
11. The mean of 20 observations was found to be 40. It was later discovered that 25 and 36 were misread as 23 and 42, then find the correct mean.
 (1) 41 (2) 39
 (3) 38.8 (4) 39.8
12. Find the arithmetic mean of $1, 3, 3^2, \dots, 3^{n-1}$.
 (1) $\frac{3^{n-1}}{n}$ (2) $\frac{3^n - 1}{2n}$
 (3) $\frac{3^{n-1}}{2n}$ (4) $\frac{3^n - 1}{n}$
13. Find the mean of the data $x, x + a, x + 2a, x + 3a, \dots$ ($2n + 1$) terms.
 (1) $x + an$ (2) $\frac{x + an}{n}$
 (3) $\frac{x + an}{2}$ (4) $\frac{x + an}{2n + 1}$
14. Observations of some data are $\frac{x}{5}, x, \frac{x}{3}, \frac{2x}{3}, \frac{x}{4}, \frac{2x}{5}$ and $\frac{3x}{4}$ where $x > 0$. If the median of the data is 4, then find the value of ' x '.
 (1) 4 (2) 6
 (3) 8 (4) 10
15. For the given data, $SD = 10$, $AM = 20$ the coefficient of variation is _____.
 (1) 47 (2) 24
 (3) 44 (4) 50
16. Upper quartile of the data 4, 6, 7, 8, 9 is _____.
 (1) 7 (2) 8
 (3) 8.5 (4) 7.5
17. The range of 8, 17, 28, 16, 30, 28, 15, 5, 19 and 35 is _____.
 (1) 20 (2) 18
 (3) 30 (4) 16

18. If the variance of the series of the form $5x_i + 7$ is 225, then standard deviation of the series of the form $7x_i + 5$ is ____.

(1) 21 (2) 441
(3) 484 (4) 22

19. Find the quartile deviation of 4, 6, 9, 12, 18, 20, 23, 27, 34, 48 and 53.

(1) 12.5 (2) 13
(3) 12 (4) 11.5

20. Find the standard deviation of 210, 240, 250, 260, 220, 230 and 270.

(1) 18 (2) 20
(3) 22 (4) 25

21. Find the median of the following data.

x	5	6	10	12	13	15
f	7	8	15	13	9	8

(1) 12 (2) 13
(3) 10 (4) 15

22. Find the mean of the following continuous distribution.

C.I.	0-10	10-20	20-30	30-40	40-50
frequency	7	5	3	4	6

(1) 23.8 (2) 22.8
(3) 25.8 (4) 24.8

23. Find the mode of the following data.

C.I.	0-4	4-8	8-12	12-16	16-20
f	5	6	19	12	8

(1) 10.6 (2) 12
(3) 12.6 (4) 8

24. If the difference between the standard deviation and variance of a data is 12, then find the sum of the variance and standard deviation of that data.

(1) 20 (2) 15
(3) 18 (4) 22

25. The mean of 25 observations is 32. It was later discovered that 38 and 29 are misread as 25 and 42. Find the correct mean.

(1) 36 (2) 32
(3) 34 (4) 33

26. The mean of following distribution is 6.5 then find the value of k.

x	2	4	6	8	10
f	5	3	7	6	k

(1) 5 (2) 4
(3) 7 (4) 8

27. If the difference between the mode and the median is 36, then find the difference between the median and the mean.

(1) 16
(2) 33
(3) 18
(4) 32

28. Find the median of the following data.

Class interval	0-20	20-40	40-60	60-80	80-100
Frequency	8	10	12	9	9

(1) 45 (2) 40
(3) 55 (4) 50

29. In a class of 20 students, 10 boys brought 11 books each and 6 girls brought 13 books each. Remaining students brought atleast one book each and no two students brought the same number of books. If the average number of books brought in the class is a positive integer, then what could be the total number of books brought by the remaining students?

(1) 12 (2) 16
(3) 14 (4) 8

30. Which of the following is not changed for the observations 31, 48, 50, 60, 25, 8, 3x, 26, 32? (where x lies between 10 and 15).

(1) A.M.
(2) Range
(3) Median
(4) Q.D.

31. In first generation of computers, _____ are used.

(1) Transistors
(2) IC
(3) Vacuum tubes
(4) None of these

32. 1 MB = _____ KB.

(1) 2^8 (2) 2^{20}
(3) 2^9 (4) 2^{10}

33. To display the output of the program, _____ keyword is used.

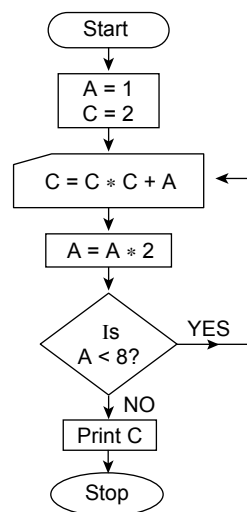
- (1) PRINT
- (2) REM
- (3) INPUT
- (4) LET

34. Find the output of the program given below, if $x = 48$ and $y = 60$.

```
10 READ x, y
20 Let  $x = x/3$ 
30 Let  $y = x + y + 8$ 
40  $z = y/4$ 
50 PRINT z
60 End
```

- | | |
|--------|--------|
| (1) 21 | (2) 22 |
| (3) 23 | (4) 24 |

35.



- | | |
|---------|---------|
| (1) 212 | (2) 532 |
| (3) 244 | (4) 733 |

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. 0 – 10, 10 – 20, 20 – 30 are the classes, the lower boundary of the class 20 – 30 is ____.

- | | |
|--------|----------|
| (1) 10 | (2) 10.5 |
| (3) 20 | (4) 20.5 |

2. The lower limit and the length of an exclusive class interval are 15 and 25 respectively. Then the class mark is ____.

- | | |
|----------|----------|
| (1) 26.5 | (2) 27.5 |
| (3) 28 | (4) 27 |

3. 1 – 5, 6 – 10, 11 – 15 are the classes of a distribution, the upper boundary of the class 1 – 5 is ____.

- | | |
|-------|---------|
| (1) 5 | (2) 5.5 |
| (3) 6 | (4) 6.5 |

4. If the lower boundary of an exclusive class is 25 and the length of the class is 9, then the upper boundary of the same class is ____.

- | | |
|----------|--------|
| (1) 34 | (2) 33 |
| (3) 33.5 | (4) 36 |

5. $2(\text{Median} - \text{Mean}) = \text{Mode} - \text{_____}$.

- | | |
|------------|--------------|
| (1) Mean | (2) 2 Mean |
| (3) Median | (4) 3 Median |

6. If 17 observations are arranged in ascending order, then median is ____ observation. (8th/9th)

- | | |
|---------|----------|
| (1) 7th | (2) 8th |
| (3) 9th | (4) 10th |

7. Consider the data; 2, x , 3, 4, 5, 2, 4, 6, 4 where $x > 2$. The mode of the data is ____.

- | | |
|-------|-------|
| (1) 2 | (2) 3 |
| (3) 4 | (4) 5 |

8. The arithmetic mean of 5, 6, 8, 9, 12, 13, 17 is

- | | |
|--------|--------|
| (1) 20 | (2) 15 |
| (3) 10 | (4) 25 |

9. If the mean of squares of first n natural numbers is 105, then $n = \text{_____}$.

- | | |
|--------|--------|
| (1) 16 | (2) 17 |
| (3) 15 | (4) 18 |

10. If the average wage of 100 workers is 3000, and the average wage of 25 of them is 4500, then find the average wage of the remaining.

- | | |
|----------|----------|
| (1) 2500 | (2) 3500 |
| (3) 4000 | (4) 2000 |

11. If the difference between median and mean of a moderately symmetric distribution is 12, then find the difference between mode and mean.

- (1) 36 (2) 24
(3) 12 (4) 16

12. Find the arithmetic mean of the series 1, 3, 5,
($2n - 1$).

- (1) n
(2) $2n$
(3) $n/2$
(4) $n - 1$

13. A sequence, a, ax, ax^2, \dots, ax^n , has odd number of terms. Find its median.

- (1) ax (2) $a\sqrt{x}$
(3) $a\sqrt[n]{x}$ (4) ax^2

14. The mean of 20 observations is 15. One observation, 20 is deleted and two more observations are included to the data. If the mean of new set of observations is 15, then find the sum of the two new observations included.

- (1) 30 (2) 35
(3) 33 (4) 32

15. The lower quartile of the data 5, 7, 8, 9, 10 is ____.

- (1) 7 (2) 6
(3) 6.5 (4) 5.5

16. Upper quartile of the data 4, 6, 7, 8, 9 is ____.

- (1) 8.5 (2) 8
(3) 7.5 (4) 7

17. The standard deviation of $3x + 5, 3x + 7, 3x + 9, 3x + 11, 3x + 13, 3x + 15$ and $3x + 17$ is ____.

- (1) 2 (2) 3
(3) 4 (4) 1

18. If the lower and upper quartiles of a data are 4 and 12, then the quartile deviation is ____.

- (1) 2 (2) 4
(3) 6 (4) 8

19. Find the variance of the series 5, 8, 11, 14 and 17.

- (1) 17 (2) 18
(3) 16 (4) 12

20. Find the arithmetic mean of the following data.

x	6	8	10	12	14
f	9	7	15	13	6

- (1) 13 (2) 12
(3) 11 (4) 10

21. Find the median of the following data.

C.I.	0-10	10-20	20-30	30-40	40-50
f	5	8	12	14	11

- (1) 20 (2) 25
(3) 30 (4) 35

22. Find the mean of the following data: Range of first n natural numbers, range of negative integers from $-n$ to -1 (where $-n < -1$), range of first n positive even integers and range of first n positive odd integers.

- (1) $3(n - 1)$ (2) $\frac{3}{2}(n - 1)$
(3) $\frac{3n}{2}$ (4) $3n$

23. In finding the mode for a data the length of class interval is 10, L_1 is 45.5 and $\Delta_1 + \Delta_2 = 50$. Which of the following can't be the mode?

- (1) 47 (2) 45
(3) 48 (4) 53

24. The average weight of 70 students is 53 kg and the average weight 30 of them is 48 kg. Find the average weight of remaining students in kg.

- (1) 56 (2) 56.5
(3) 56.75 (4) 56.25

25. Find the median of the following data.

x	14	18	22	25	30
f	7	10	12	16	5

- (1) 20 (2) 19
(3) 21 (4) 22

26. Find the mean of the following continuous distribution.

Class Interval	10-15	15-20	20-25	25-30	30-35
Frequency	8	11	6	13	12

- (1) 23 (2) 23.5
(3) 24 (4) 24.5

27. Find the mode of the following data.

Class Interval	0-10	10-20	20-30	30-40	40-50
Frequency	5	8	7	6	4

- (1) 16.5 (2) 17.5
(3) 18 (4) 18.5

28. The mean of 8 observations was found to be 20. Later it was detected that one of the observations was misread as 62. What is the correct observation, if the correct mean is 15.5?

(1) 26 (2) 28
(3) 30 (4) 29

29. If the ratio of mean and median of a certain data is 5:7, then find the ratio of its mode and mean.

(1) 2:5 (2) 11:5
(3) 6:5 (4) 2:3

30. The mean of the following distribution is 4. Find the value of q.

x	2	3	4	5	7
f	4	4	2	3	q

(1) 2 (2) 3
(3) 0 (4) 4

31. The box indicating the decision in a flow chart is called a _____.

(1) data box (2) decision box
(3) operation box (4) None of these

32. The maximum length of an alphanumeric variable in BASIC language is _____ characters.

(1) 18 (2) 20
(3) 40 (4) 48

33. Which of the following is (are) not alphanumeric variable (s)?

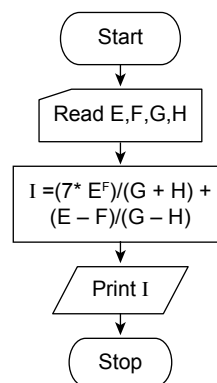
(1) PIN (2) P
(3) P12 (4) All of these

34. Find the output of the program given below.

```
10 REM Average of ten numbers
20 READ n1, n2, n3, n4 ..... n10
30 DATA 2, 4, 14, 8, 22, 32, 44, 58, 74, 92
40 Let Average =
(n1 + n2 + n3 + n4 + n5 + n6 + n7 + n8 + n9 + n10)/10
50 PRINT "Average = "; Average
60 END
```

(1) Average = 30 (2) Average = 35
(3) Average = 38 (4) Average = 42

- 35.



If the values of E, F, G and H are 2, 10, 9 and 5 respectively, then find the output of the flowchart.

(1) 510 (2) 520
(3) 500 (4) 490

ANSWER KEYS

PRACTICE EXERCISE 9 (A)

1. 4	2. 2	3. 2	4. 3	5. 2	6. 3	7. 3	8. 2	9. 3	10. 4
11. 4	12. 2	13. 1	14. 4	15. 4	16. 3	17. 3	18. 1	19. 1	20. 2
21. 3	22. 1	23. 1	24. 1	25. 2	26. 3	27. 3	28. 4	29. 1	30. 2
31. 3	32. 4	33. 1	34. 4	35. 1					

PRACTICE EXERCISE 9 (B)

1. 3	2. 2	3. 2	4. 1	5. 3	6. 3	7. 3	8. 3	9. 2	10. 1
11. 1	12. 1	13. 3	14. 2	15. 2	16. 1	17. 3	18. 2	19. 2	20. 4
21. 3	22. 2	23. 2	24. 3	25. 4	26. 2	27. 2	28. 1	29. 2	30. 2
31. 2	32. 3	33. 4	34. 2	35. 1					

Permutations and Combinations and Probability

SYNOPSIS

Counting Techniques

This chapter offers some techniques of counting without direct listing of the number of elements in a particular set or the number of outcomes of a particular experiment. We now present the two fundamental rules of counting, namely (i) **The Sum Rule** and (ii) **The Multiplication Rule** or Product rule.

Sum Rule of disjoint counting: If there are two sets say A and B with A having m elements and B having n elements with no element in A appearing in B, then the number of elements in A or B is $(m + n)$.

Symbolically, $n(A \cup B) = n(A) + n(B)$, when A and B are disjoint

The symbol \cup stands for Union.

General form of Sum Rule: If A and B are two sets, then the number of elements in A or B (not necessarily disjoint) is given by

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

The symbol \cap stands for intersection. It means 'common to'.

Product Rule or Multiplication Rule: If two operations must be performed, and if the first operation can be performed in p_1 ways and the second in p_2 ways, then there are $p_1 \times p_2$ different ways in which the two operations can be performed one after the other.

- **Generalization of Product Rule:** Suppose that tasks $T_1, T_2, T_3, \dots, T_r$ are to be performed in a sequence. If T_1 can be performed in p_1 ways, and for each of these ways, T_2 can be performed in p_2 ways, and for each of these $p_1 \times p_2$ ways of performing T_1, T_2 in sequence, T_3 can be performed in p_3 ways and so on, then the sequence $T_1, T_2, T_3, \dots, T_r$ can be performed in $p_1 \times p_2 \times p_3 \times \dots \times p_r$ ways.
- **Permutations:** Each of the arrangements which can be made by taking some or all of a number of things is called a Permutation. Permutation implies "arrangement" i.e., order of things is important.
- **General formula for Permutations with repetitions allowed:** The number of permutations of n distinct objects taken r at a time with repetition allowed is n^r , for any integer $r \geq 0$.
Explanation: We have r boxes with each box ready to accept one or more of the n distinct objects. Using product rule, the total ways of filling up these r boxes is $n \times n \times n \times \dots$ for r times $= n^r$.
- **Combinations:** Each of the groups or selections which can be made by taking some or all of a number of things is called a Combination.
In combinations, the order in which the things are taken is not considered as long as the specific things are included.
- **General Formula for Combinations:** We first look at the permutations of n items taken r at a time from a different perspective. We look at two tasks T_1 and T_2 as:

T_1 : Select r objects. T_2 : Arrange all the r objects that got selected in T_1 . We understand that T_1 can be done in nC_r ways by definition, and its value yet to be determined and T_2 can be done in $r!$ ways. But then to get the permutations, we need to perform T_1 followed by T_2 .

Thus by Fundamental Principle of Counting, both tasks can be done in ${}^nC_r \times r!$ ways.

$$\text{Thus } {}^nC_r \times r! = {}^nP_r \text{ i.e., } {}^nC_r = \frac{{}^nP_r}{r!} = \frac{n!}{(n-r)!r!}$$

Note:

- (1) ${}^nC_0 = {}^nC_n = 1$
- (2) ${}^nC_1 = {}^nC_{n-1} = n$
- (3) If ${}^nC_r = {}^nC_s$, then $r = s$ or $n = r + s$.

Factorial Notation and nC_r Representation

The factorial of n is denoted by $n!$ and is defined as $n! = 1 \times 2 \times 3 \times \dots \times (n-1) \times n$

Also, $0! = 1$ and $n! = n(n-1)!$.

For $0 \leq r \leq n$, we define nC_r as ${}^nC_r = \frac{n!}{(n-r)!r!}$

$$\text{for example, } {}^6C_2 = \frac{6!}{(6-2)!2!} = \frac{6 \times 5 \times 4!}{4! \times 2!} = 15$$

Probability

Probability theory is the study of indeterministic phenomena. Examples are tossing of coins, rolling dice, picking cards from well-shuffled decks and drawing objects from different containers, containing different objects. All these are examples of **random experiments** – situations in which we do something and we are not sure of the outcome, because there is more than one possible outcome.

- **Sample space:** The set of all possible outcomes of an experiment is called its sample space. It is usually denoted by S .
For example, When we toss an unbiased coin, the result can be a head(H) or a tail(T). So the sample space(S) = {H, T}.
- **Event:** The outcomes or a combination of the outcomes is called an event. The probability of an event (E) is a measure of our belief that the event will occur. This may be zero, i.e., we don't expect the event to occur at all. E.g., If two dice are rolled, the probability that the sum of the numbers which will come up is 1 is

zero. The probability may be 1, i.e., we are absolutely certain that the event will occur. E.g., If a coin is tossed the probability that we get a head or a tail is 1. But in general, we may believe that the event may occur but we are not absolutely certain i.e., $0 < p < 1$.

- **Probability of an event:** Let E be an event of a certain experiment whose outcomes are equally likely. Then, the probability of the event E , denoted by $P(E)$, is defined as

$$P(E) = \frac{\text{Number of outcomes favourable to } E}{\text{Total number of possible outcomes}}$$

- **Probability of non-occurrence of an event E :** Let a random experiment have n possible outcomes – all equally likely. Say m of these are favourable for an event E . Then, there are $(n - m)$ outcomes which are not favourable to the event E .

Let \bar{E} denote the non-occurrence of E .

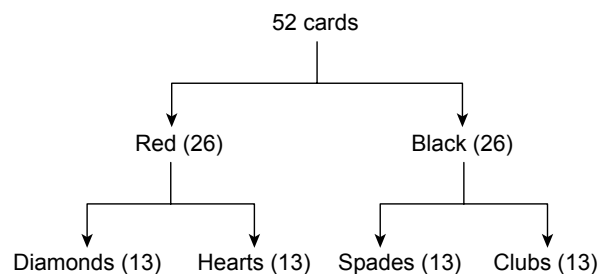
Then, $P(\bar{E}) = \frac{n-m}{n}$, i.e., $P(\text{non-occurrence of } E)$

$$P(\bar{E}) = \frac{n-m}{n}$$

$$\text{Now, } P(E) + P(\bar{E}) = \frac{m}{n} + \frac{n-m}{n} = \frac{m+(n-m)}{n} = \frac{n}{n} = 1 \text{ i.e.}$$

$$P(E) + P(\bar{E}) = 1$$

Classification of a Pack (or deck) of Cards



The cards in each suit are ace(A), king(K), queen(Q), Jack(J), 10, 9, 8, 7, 6, 5, 4, 3 and 2. The cards A, J, Q and K are called honours and the cards 2, 3, 4, 5, 6, 7, 8, 9 and 10 are called numbered cards. The cards J, Q and K are called face cards.

Solved Examples

1. A man has 7 trousers and 10 shirts. How many different outfits can he wear?

☞ **Solution:** Task 1: He may choose the trouser in 7 ways.

Task 2: He may choose the shirt in 10 ways.

According to the Product Rule, the total number of different outfits is 7×10 i.e., 70.

2. A password of 4 letters is to be formed with vowels alone. How many such passwords are possible if
- repetition of letters is allowed,
 - repetition of letters is not allowed?

☞ **Solution:** The tasks T_1, T_2, T_3 and T_4 are about filling the 1st, 2nd, 3rd and 4th slots in the password.

- (i) The first slot can be filled in 5 ways (a, e, i, o or u).
The second can also be filled in 5 ways (with repetition being allowed).

The third and fourth can also be filled in 5 ways each.

Using the generalization, we get $5 \times 5 \times 5 \times 5 = 625$ passwords.

- (ii) The first slot can be filled in 5 ways (a, e, i, o or u). The second slot can be filled in 4 ways (as repetition is not allowed).

The third and fourth in 3 and 2 ways respectively.

Thus the total number of possible passwords are $5 \times 4 \times 3 \times 2 = 120$.

3. There are 10 railway stations between a station x and another station y. Find the number of different tickets that must be printed so as to enable a passenger to travel from any one station to any other.

☞ **Solution:** Including x and y there are 12 stations. From any one station to any other, we need 11 different types of tickets. Since there are 12 stations, the different tickets possible are $(12)(11) = 132$.

4. In how many ways can 8 athletes finish a race for Gold, Silver and Bronze medals?

☞ **Solution:** This is the number of permutations of 8 distinct objects taken three at a time without repetitions (here it means same person cannot get both silver and bronze). Thus ${}^8P_3 = 8 \times 7 \times 6 = 336$ ways.

5. In a library there are 10 research scholars. In how many ways can we select 4 of them?

☞ **Solution:** Out of 10 scholars, we can select 4 of them in ${}^{10}C_4$ ways. ${}^{10}C_4 = \frac{10 \times 9 \times 8 \times 7}{1 \times 2 \times 3 \times 4} = 210$ ways.

6. There are 25 points in a plane. Six of these are collinear and no other combination of 3 points are collinear. How many different straight lines can be formed by joining these points?

☞ **Solution:** A straight line is formed by joining any two points.

\therefore The number of straight lines that can be formed by joining 25 points is ${}^{25}C_2$

But 6 points are collinear.

\therefore These 6 points form only one line instead of 6C_2 lines.

\therefore The total number of lines that can be formed is ${}^{25}C_2 - {}^6C_2 + 1 = 300 - 15 + 1 = 286$.

7. When a fair dice is rolled, what is the probability of getting a number less than 5?

☞ **Solution:** When a fair dice is rolled, the total number of possible outcomes is 6. Let E be the required event. Then, the outcomes favourable to E are 1, 2, 3 and 4. i.e., 4 favourable outcomes.

$$\Rightarrow P(E) = \frac{4}{6} = \frac{2}{3}$$

Hence, the probability of getting a number less than 5 is $2/3$.

8. When a dice is rolled, what is the probability of getting a number 2 or 3?

☞ **Solution:** Total number of possible outcomes = 6. Favourable outcomes are 2 and 3 i.e., 2 favourable outcomes. \therefore Required probability = $2/6 = 1/3$

9. A bag contains 3 blue and 7 red balls. Find the probability that a ball selected at random from the bag will be a blue ball.

☞ **Solution:** Total number of balls in the bag = $3 + 7 = 10$. So, a ball can be selected from the bag in 10 ways. Now, there are 3 blue balls in the bag. So, a blue ball can be selected from the bag in 3 ways. Hence, the required probability = $3/10$.

10. A basket contains ten mangoes out of which 3 are rotten. If three mangoes are chosen at random, find the probability that all the mangoes will be good.

👉 **Solution:** A basket contains ten mangoes out of which 3 are rotten. And if three mangoes are chosen at random. \therefore Total number of possible outcomes, $n(S) = {}^{10}C_3$

All the three mangoes are good. \therefore The number of favourable outcomes, $n(E) = {}^7C_3$

$P(\text{all the three are good})$

$$= \frac{n(E)}{n(S)} = \frac{{}^7C_3}{{}^{10}C_3} = \frac{(7)(6)(5)}{(10)(9)(8)} = \frac{7}{24}$$

PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- In 6C_r , r can be _____.
 - 2
 - 4
 - 6
 - All of these
- If ${}^nC_r = {}^nP_r$, then r can be _____.
 - 0
 - 1
 - 3
 - Either (1) or (2)
- If ${}^nP_{100} = {}^nP_{99}$, then find the value of n .
 - 200
 - 100
 - 150
 - None of these
- A box contains 8 different pens and 10 different pencils. In how many ways can 3 pens be selected from the box?
 - ${}^{10}C_3$
 - 8C_3
 - ${}^{18}C_3$
 - None of these
- ${}^nP_n =$ _____.
 - $n!$
 - $(n-1)!$
 - 1
 - $(n+1)6$
- ${}^5C_4 =$ _____.
 - 4
 - 5
 - 20
 - 24
- The number of arrangements that can be made by taking r objects taken at a time from a group of n dissimilar objects, is denoted as _____.
 - nC_r
 - nP_r
 - ${}^nP_{n-r}$
 - ${}^nC_{n-r}$
- How many three-digit numbers that are divisible by 5, can be formed, using the digits 0, 2, 3, 5, 7, if no digit occurs more than once in each number?
 - 21
 - 12
 - 9
 - 15
- A committee of 5 members is to be formed from 8 men and 6 women. Find the number of ways of forming the committee, if it has to contain 3 men and 2 women.
 - 420
 - 210
 - 840
 - 1220
- How many 6-letter words with distinct letters in each can be formed using the letters of the word EDUCATION? How many of these begin with I?
 - ${}^9P_6, {}^8P_5$
 - ${}^9P_6, {}^9P_5$
 - ${}^8P_6, {}^8P_5$
 - ${}^8P_6, {}^8P_4$
- Twenty points are marked on a plane so that no three points are collinear except 7 points. How many triangles can be formed by joining the points?
 - 995
 - 1105
 - 1200
 - 1250
- There are four different white balls and four different black balls. The number of ways that balls can be arranged in a row so that white and black balls are placed alternately is _____.
 - $(4!)^2$
 - $2(4!)^2$
 - $4!$
 - $(4!)^3$
- Find the number of ways in which five bowlers of different ages can choose to bowl on over each one after the other, if the oldest bowler should not bowl the first over.
 - 96
 - 84
 - 92
 - 98
- A bag contains 3 yellow balls and 4 pink balls. In how many ways can 2 pink balls and 1 yellow ball be drawn from the bag?
 - 24 ways
 - 8 ways
 - 12 ways
 - 18 ways
- In how many ways can 8 books be distributed among 5 students, if each student is eligible for any number of books?
 - 40
 - 5^8
 - 360
 - 8^5
- In a party there are 20 persons. If every person shook hand with every other person in the party exactly once, find the total number of handshakes exchanged in the party.
 - 420
 - 20
 - 380
 - 190
- Find the number of integers greater than 4000 that can be formed by using the digits 3, 4, 5 and 2, if every digit can occur at most once in any number.
 - 6
 - 18
 - 12
 - 24

18. When a number is selected from a set of natural numbers, the probability of getting a number which is a multiple of 1 is ____.
- (1) 1 (2) $\frac{1}{3}$
(3) $\frac{1}{2}$ (4) 0
19. The probability of getting both heads when two coins are tossed at a time, is ____.
- (1) 1 (2) 0
(3) $\frac{1}{2}$ (4) $\frac{1}{4}$
20. When a dice is rolled, find the probability of getting a number which is a factor of 4.
- (1) $\frac{1}{2}$ (2) $\frac{1}{3}$
(3) $\frac{1}{4}$ (4) $\frac{5}{6}$
21. If a vowel is selected at random from the English alphabet, then what is the probability that it is u?
- (1) $\frac{1}{26}$ (2) $\frac{1}{5}$
(3) $\frac{5}{26}$ (4) $\frac{3}{26}$
22. A card is selected at random from a well shuffled pack of cards. What is the probability that it will be a numbered card?
- (1) $\frac{1}{52}$
(2) $\frac{1}{3}$
(3) $\frac{9}{13}$
(4) $\frac{5}{13}$
23. If two coins are tossed, then find the probability of getting two tails.
- (1) $\frac{1}{4}$ (2) $\frac{1}{3}$
(3) $\frac{1}{2}$ (4) $\frac{1}{6}$
24. Each of three persons a single throw with a dice. Find the probability of getting the same number on all the dice.
- (1) $\frac{1}{216}$ (2) $\frac{1}{6}$
(3) $\frac{1}{36}$ (4) $\frac{1}{108}$
25. If a 5-digit number is formed by using the digits 1, 2, ..., 9 (without repetitions), then what is the probability that it will be an even number?
- (1) $\frac{5}{13}$ (2) $\frac{4}{9}$
(3) $\frac{3}{8}$ (4) $\frac{5}{11}$
26. If a letter is selected at random from the letters of the word TRIANGLE, then what is the probability that it will be a consonant?
- (1) $\frac{2}{7}$ (2) $\frac{3}{8}$
(3) $\frac{5}{8}$ (4) $\frac{1}{8}$
27. One ticket is drawn from a bag containing 70 tickets numbered 1 to 70. Find the probability that it is a multiple of 5 or 7.
- (1) $\frac{1}{10}$ (2) $\frac{1}{70}$
(3) $\frac{6}{70}$ (4) $\frac{11}{35}$
28. A four-digit number is formed by using the digits 1, 2, 4, 8 and 9 without repetition. If one number is selected from those numbers, then what is the probability that it will be an odd number?
- (1) $\frac{1}{5}$ (2) $\frac{2}{5}$
(3) $\frac{3}{5}$ (4) $\frac{4}{5}$
29. If n coins are tossed, then find the probability of not getting either all heads or all tails.
- (1) $1 - \frac{1}{2^n}$ (2) $\frac{1}{2^{n-1}}$
(3) $1 - \frac{1}{2^{n+1}}$ (4) $1 - \frac{1}{2^{n-1}}$
30. Each of two persons a single throw with a dice. What is the probability of getting the same number on both the dice?
- (1) $\frac{1}{6}$ (2) $\frac{5}{6}$
(3) $\frac{1}{36}$ (4) $\frac{2}{3}$

PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Find the value of ${}^{10}C_{10}$.

- (1) 2 (2) 1
(3) 4 (4) 6

2. If ${}^nC_3 = {}^nC_5$, then find the value of n .

- (1) 9 (2) 10
(3) 8 (4) 7

3. In Hyderabad, there are 5 routes to Begumpet from Kukatpally and 9 routes to Dilsukhnagar from

Begumpet. In how many ways can a person travel from Kukatpally to Dilsukhnagar via Begumpet?

- (1) 14 (2) 4
(3) 40 (4) 45

4. In how many ways can 15 students be selected for a cricket team from a class of 25 students?
- (1) ${}^{15}C_{15}$ (2) ${}^{25}C_0$
(3) ${}^{25}C_{25}$ (4) ${}^{25}C_{15}$
5. If ${}^{100}C_3 = 161700$, then ${}^{100}C_{97}$ is equal to ____.
- (1) 53,900 (2) 40,425
(3) 1,61,700 (4) 16,17,000
6. ${}^5P_4 =$ ____.
- (1) 720 (2) 120
(3) 60 (4) 360
7. The number of different straight lines that can be formed by joining n points in a plane, where no three points are collinear, is ____.
- (1) nC_3 (2) nC_2
(3) nP_3 (4) nP_2
8. The number of different triangles that can be formed by joining n points on a plane, where no three points are collinear, is ____.
- (1) nP_3 (2) $2 \times {}^nP_3$
(3) $2 \times {}^nC_3$ (4) nC_3
9. From 8 boys and 5 girls, a delegation of 5 students is to be formed. Find the number of ways this can be done such that delegation must contain exactly 3 girls.
- (1) 280 (2) 560
(3) 1120 (4) 2240
10. Three persons entered a railway compartment in which 5 seats were vacant. Find the number of ways in which they can be seated.
- (1) 30 (2) 45
(3) 120 (4) 60
11. If ${}^nP_r = 360$ and ${}^nC_r = 15$, then find the value of r .
- (1) 5 (2) 4
(3) 3 (4) 2
12. How many words can be formed, using all the letters of the word SPECTRA so that all the vowels are always together?
- (1) 720 (2) 360
(3) 1440 (4) 180

13. Find the number of 5-digit odd numbers that can be formed using the integers from 3 to 9, if no digit is to occur more than once in any number.

- (1) 1440 (2) 180
(3) 360 (4) 720

14. In a party, there are 10 married couples. Each person shakes hands with every person other than her or his spouse. The total number of hand-shakes exchanged in that party is ____.

- (1) 160 (2) 190
(3) 180 (4) 170

15. How many four-digit odd numbers can be formed using the digits 0, 2, 3, 5, 6, 8 (each digit occurs only once)?

- (1) 64 (2) 72
(3) 86 (4) 96

16. In how many ways can 3 diamond cards be drawn simultaneously from a pack of cards?

- (1) 78 (2) 1716
(3) 286 (4) 13

17. Find the number of four-digit numbers that can be formed using the digits 1, 2, 5, 7, 4 and 6, if every digit can occur at most once in any number.

- (1) 120
(2) 360
(3) 720
(4) 1440

18. If A is any event in a sample space, then $P(A')$ is ____.

- (1) $P(A)$ (2) $1 + P(A)$
(3) $1 - P(A)$ (4) $1 - 2P(A)$

19. If a number is selected at random from the numbers from 1 to 100, then what is the probability that it is a multiple of 10?

- (1) $1/5$ (2) $1/20$
(3) $1/10$ (4) $1/40$

20. A card is selected at random from a well shuffled pack of cards. What is the probability that it will be honours card?

- (1) $1/13$ (2) $4/13$
(3) $2/13$ (4) $3/13$

21. When a dice is rolled, find the probability of getting a number less than or equal to 5.

- (1) $\frac{5}{6}$ (2) $\frac{1}{6}$
(3) $\frac{1}{2}$ (4) $\frac{2}{3}$
22. If two dice are rolled, find the probability that numbers coming up on both the dice will be multiples of 3.
(1) $\frac{1}{9}$ (2) $\frac{1}{18}$
(3) $\frac{1}{36}$ (4) $\frac{1}{12}$
23. If 8 boys are arranged in a row, what is the probability that 3 particular boys always sit together?
(1) $\frac{3}{28}$ (2) $\frac{5}{28}$
(3) $\frac{3}{16}$ (4) $\frac{5}{16}$
24. What is the probability that a non-leap year has 53 Fridays?
(1) $\frac{2}{7}$ (2) $\frac{3}{7}$
(3) $\frac{1}{7}$ (4) $\frac{5}{7}$
25. A bag contains 8 mangoes, 6 pine apples and x oranges. If the probability of selecting a pine apple is $\frac{1}{3}$, then find the number of oranges in the bag.
(1) 3 (2) 5
(3) 4 (4) 10
26. A purse contains four fifty-paise coins, three two-rupees coins and three five-rupee coins. If three coins are selected at random, then what is the probability of getting the minimum amount?
- (1) $\frac{1}{15}$ (2) $\frac{1}{10}$
(3) $\frac{1}{30}$ (4) $\frac{1}{5}$
27. Three numbers are chosen from 1 to 15. Find the probability that they are consecutive.
(1) $\frac{1}{35}$ (2) $\frac{1}{13}$
(3) $\frac{2}{13}$ (4) $\frac{3}{35}$
28. If a 5-digit number is formed by using the digits 1, 2, 9 (without repetitions), then what is the probability that it will be an even number?
(1) $\frac{7}{36}$ (2) $\frac{3}{11}$
(3) $\frac{4}{9}$ (4) $\frac{5}{18}$
29. All the cards in an ordinary deck of 52 cards are numbered from 1 to 52. If a card is drawn at random from the deck, then what is the probability that it will have a prime number?
(1) $\frac{7}{26}$ (2) $\frac{1}{4}$
(3) $\frac{3}{13}$ (4) $\frac{15}{52}$
30. An urn contains 5 red, 3 black and 2 white. If three balls are chosen at random, then what is the probability that they will be of different colours?
(1) $\frac{1}{2}$ (2) $\frac{1}{4}$
(3) $\frac{3}{11}$ (4) $\frac{4}{15}$

ANSWER KEYS

PRACTICE EXERCISE 10 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 4 | 3. 2 | 4. 2 | 5. 1 | 6. 2 | 7. 2 | 8. 1 | 9. 3 | 10. 1 |
| 11. 2 | 12. 2 | 13. 1 | 14. 4 | 15. 2 | 16. 4 | 17. 3 | 18. 1 | 19. 4 | 20. 1 |
| 21. 2 | 22. 3 | 23. 1 | 24. 3 | 25. 2 | 26. 3 | 27. 4 | 28. 2 | 29. 4 | 30. 1 |

PRACTICE EXERCISE 10 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 4 | 4. 4 | 5. 3 | 6. 2 | 7. 2 | 8. 4 | 9. 1 | 10. 4 |
| 11. 2 | 12. 3 | 13. 1 | 14. 3 | 15. 4 | 16. 3 | 17. 2 | 18. 3 | 19. 3 | 20. 2 |
| 21. 1 | 22. 1 | 23. 1 | 24. 3 | 25. 3 | 26. 3 | 27. 1 | 28. 3 | 29. 4 | 30. 2 |

Binomial Theorem and Mathematical Induction

SYNOPSIS

The process of mathematical induction is an indirect method which helps us to prove complex mathematical formulae, that cannot be easily proved by direct methods.

The Principle of Mathematical Induction

If $P(n)$ is a statement such that,

- (i) $P(n)$ is true for $n = 1$
- (ii) $P(n)$ is true for $n = k + 1$, when it is true for $n = k$, where k is a natural number then the statement $P(n)$ is true for all natural numbers.
- An algebraic expression containing only two terms is called a binomial expression.

$$(x + y)^1 = x + y$$

$$(x + y)^2 = x^2 + 2xy + y^2$$

$$(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$$

$$(x + y)^4 = x^4 + 4x^3y + 6x^2y^2 + 4xy^3 + y^4$$

In the above examples, the coefficients of the variables in the expansions of the powers of the binomial expression are called binomial coefficients.

When the binomial coefficients are listed, for different values of $n \in \mathbb{N}$, we see a definite pattern being followed. This pattern is given by the Pascal Triangle.

Pascal Triangle

The exponent of the binomial	The coefficients of the terms in the expansion
1	1 1
2	1 2 1
3	1 3 3 1
4	1 4 6 4 1
5	1 5 10 10 5 1

This pattern, shown above, can be used to write the binomial expansion for higher powers.

- **Binomial theorem:** If n is a positive integer,

$$(x + y)^n = {}^nC_0 x^n + {}^nC_1 x^{n-1}y + {}^nC_2 x^{n-2}y^2 + \dots + {}^nC_r x^{n-r}y^r + \dots + {}^nC_n y^n$$

Important Inferences from the above Expansion

1. The number of terms in the expansion is $n + 1$.
2. From left to right, in every successive term of the expansion the exponent of x increases with simultaneous decrease in the exponent of y by 1.

- In each term of the expansion, the sum of the exponents of x and y is equal to the exponent (n) of the binomial expression.
- The coefficients of the terms that are equidistant from the beginning and the end have numerically equal values, i.e., ${}^nC_0 = {}^nC_n$; ${}^nC_1 = {}^nC_{n-1}$; ${}^nC_2 = {}^nC_{n-2}$ and so on.
- The general term in the expansion of $(x + y)^n$ is given by $T_{r+1} = {}^nC_r x^{n-r} y^r$.
- On substituting ' $-y$ ' in the place of ' y ' in the expansion, we get
 $(x - y)^n = {}^nC_0 x^n - {}^nC_1 x^{n-1} y + {}^nC_2 x^{n-2} y^2 - {}^nC_3 x^{n-3} y^3 + \dots + (-1)^n {}^nC_n y^n$
 The general term in the expansion $(x - y)^n$ is $T_{r+1} = (-1)^r {}^nC_r x^{n-r} y^r$.

Middle Terms in the Expansion of $(x + y)^n$

Depending on the nature of n , i.e., whether n is even or odd, there may exist one or two middle terms.

Case 1: When n is an even number, then there is only one middle term in the expansion $(x + y)^n$, which is

$$\left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term.}$$

Case 2: When n is odd number, there will be two middle terms in the expansion of $(x + y)^n$, which are

$$\left(\frac{n+1}{2}\right)^{\text{th}} \text{ and } \left(\frac{n+3}{2}\right)^{\text{th}} \text{ terms.}$$

- **Term independent of x :** In an expansion of the form $\left(x^p + \frac{1}{x^q}\right)^n$, the term for which the exponent of x is

0 is said to be the term that is independent of x or a constant term.

For example, in the expansion $\left(x + \frac{1}{x}\right)^2$ is

$$= x^2 + 2 + \frac{1}{x^2}, \text{ the 2nd term is independent of 'x'.$$

- **The greatest coefficient in the expansion of $(1 + x)^n$ (where n is a positive integer):**

The coefficient of the $(r + 1)$ th term in the expansion of $(1 + x)^n$ is nC_r .

nC_r is maximum when $r = n/2$ (if n is even) and

$$r = \frac{n+1}{2} \text{ or } \frac{n-1}{2} \text{ (if } n \text{ is odd)}$$

Numerically Greatest Term

The numerically greatest term in the expansion of $(1 + x)^n$ is found out using the following process. We calculate the

value of $\frac{(n+1)|x|}{|x|+1}$:

If $\frac{(n+1)|x|}{|x|+1} = \text{an integer, say 'k', then } k^{\text{th}} \text{ and } (k+1)^{\text{th}}$

terms are numerically greatest terms.

If $\frac{(n+1)|x|}{|x|+1}$ is not an integer, say $k + a$; where $0 <$

$a < 1$, $(k+1)^{\text{th}}$ term is numerically greatest term.

Solved Examples

- Prove that $1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$.

☞ **Solution:** Let $P(n)$: $1 + 2 + \dots + n = \frac{n(n+1)}{2}$ be the given statement.

Step 1: Put $n = 1$

Then, L.H.S. = 1 and R.H.S. = $\frac{1(1+1)}{2} = 1$.

\therefore L.H.S. = R.H.S.

$\Rightarrow P(n)$ is true for $n = 1$.

Step 2: Assume that $P(n)$ is true for $n = k$.

$$\therefore 1 + 2 + 3 + \dots + k = \frac{k(k+1)}{2}$$

Adding $(k+1)$ on both sides, we get

$$1 + 2 + 3 + \dots + k + (k+1) = \frac{k(k+1)}{2} + (k+1)$$

$$= (k+1) \left(\frac{k}{2} + 1 \right)$$

$$= \frac{(k+1)(k+2)}{2}$$

$$= \frac{(k+1)(k+1+1)}{2}$$

$\Rightarrow P(n)$ is true for $n = k + 1$

\therefore By the principle of mathematical induction
P(n) is true for all natural numbers n.

Hence, $1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$ for all $n \in \mathbb{N}$

2. Prove that $1 + 3 + 5 + \dots + (2n - 1) = n^2$

Solution: Let P(n): $1 + 3 + 5 + \dots + (2n - 1) = n^2$ be the given statement

Step 1: Put $n = 1$

Then, L.H.S. = 1

R.H.S. = $(1)^2 = 1$

\therefore L.H.S. = R.H.S.

\Rightarrow P(n) is true for $n = 1$.

Step 2: Assume that P(n) is true for $n = k$.

$\therefore 1 + 3 + 5 + \dots + (2k - 1) = k^2$

Adding $2k+1$ on both sides, we get

$$1 + 3 + 5 + \dots + (2k - 1) + (2k + 1) = k^2 +$$

$$(2k + 1) = (k + 1)^2$$

$$\therefore 1 + 3 + 5 + \dots + (2k - 1) + (2(k + 1) - 1) = (k + 1)^2$$

\Rightarrow P(n) is true for $n = k + 1$.

\therefore By the principle of mathematical induction
P(n) is true for all natural numbers 'n'.

Hence, $1 + 3 + 5 + \dots + (2n - 1) = n^2$, for all $n \in \mathbb{N}$

3. Prove that $3^{n+1} > 3(n + 1)$.

Solution: Let P(n): $3^{n+1} > 3(n + 1)$

Step 1: Put $n = 1$

Then, $3^2 > 3(2)$

\Rightarrow p(n) is true for $n = 1$

Step 2: Assume that P(n) is true for $n = k$

Then, $3^{k+1} > 3(k + 1)$

Multiplying throughout with '3'.

$$3^{k+1} \times 3 > 3(k + 1) \times 3 = 9k + 9 = 3(k + 2) +$$

$$(6k + 3) > 3(k + 2)$$

$$\Rightarrow 3^{k+1+1} > 3(k+1+1)$$

P(n) is true for $n = k + 1$

\therefore By the principle of mathematical induction,
P(n) is true for all $n \in \mathbb{N}$.

Hence, $3^{n+1} > 3(n + 1)$, $\forall n \in \mathbb{N}$

4. Prove that 7 is a factor of $2^{3n} - 1$ for all natural numbers n.

Solution: Let P(n): 7 is a factor of $2^{3n} - 1$ be the given statement

Step 1: When $n = 1$,

$$2^{3(1)} - 1 = 7 \text{ and } 7 \text{ is a factor of itself.}$$

\therefore P(n) is true for $n = 1$

Step 2: Let P(n) be true for $n = k$.

\Rightarrow 7 is a factor of $2^{3k} - 1$.

$\Rightarrow 2^{3k} - 1 = 7M$, where $M \in \mathbb{N}$.

$\Rightarrow 2^{3K} = 7M + 1 \rightarrow (1)$

Now consider $2^{3(k+1)} - 1 = 2^{3k+3} - 1 = 2^{3k} \cdot 2^3 - 1$

$$= 8(7M+1) - 1 \text{ (using (1))} = 56M + 7 \text{ (As } 2^{3k} = 7M + 1)$$

$$\therefore 2^{3(k+1)} - 1 = 7(8M + 1)$$

\Rightarrow 7 is a factor of $2^{3(k+1)} - 1$

\Rightarrow P(n) is true for $n = k + 1$

\therefore By the principle of mathematical induction,
P(n) is true for all natural numbers n.

Hence, 7 is a factor $2^{3n} - 1$ for all $n \in \mathbb{N}$.

5. Find the middle term in the expansion of $(2x + 3y)^8$.

Solution: Since n is even number, $\left(\frac{8}{2} + 1\right)^{\text{th}}$
term i.e., 5th term is the middle term in $(2x + 3y)^8$.

$$T_5 = T_{4+1} = {}^8C_4 (2x)^{8-4} (3y)^4 = {}^8C_4 (2x)^4 (3y)^4$$

6. Find the middle terms in the expansion of $(5x - 7y)^7$.

Solution: Since n is an odd number, the expansion contains two middle terms.

$\left(\frac{7+1}{2}\right)^{\text{th}}$ and $\left(\frac{7+3}{2}\right)^{\text{th}}$ terms are the two middle

terms in the expansion of $(5x - 7y)^7$.

$$T_4 = T_{3+1} = (-1)^3 {}^7C_3 (5x)^{7-3} (7y)^3$$

$$= -{}^7C_3 (5x)^4 (7y)^3$$

$$T_5 = T_{4+1} = (-1)^4 {}^7C_4 (5x)^{7-4} \times (7y)^4$$

$$= {}^7C_4 (5x)^3 (7y)^4$$

7. Find the term independent of x in $\left(x + \frac{1}{x}\right)^4$.

Solution: Let T_{r+1} be the term independent of x in the given expansion.

$$\therefore T_{r+1} = {}^4C_r x^{4-r} \left(\frac{1}{x}\right)^r = {}^4C_r \frac{x^{4-r}}{x^r} = {}^4C_r x^{4-2r}$$

For the term independent of x the power of x should be zero.

$$\therefore 4 - 2r = 0 \text{ or } r = 2.$$

$\Rightarrow T_{2+1} = T_3$, is the independent term of the expansion.

Note: If r is not a positive integer, then the expansion does not contain constant term.

8. Find the coefficient of x^2 in $\left(x^2 + \frac{1}{x^3}\right)^6$.

☞ **Solution:** Let T_{r+1} be the term containing x^2 .

$$\begin{aligned} T_{r+1} &= {}^6C_r (x^2)^{6-r} \left(\frac{1}{x^3}\right)^r \\ &= {}^6C_r x^{12-2r} \frac{1}{x^{3r}} = {}^6C_r x^{12-5r} \end{aligned}$$

As the coefficient of x is 2

$$12 - 5r = 2 \Rightarrow r = 2.$$

$$\therefore \text{Coefficient of } x^2 = {}^6C_2 = 15.$$

9. If the expansion $\left(x^2 + \frac{1}{x^3}\right)^n$ is to contain an independent term, then what should be the value of n ?

☞ **Solution:** General term, $T_{r+1} = {}^nC_r \cdot x^{n-r} \cdot y^r$,
for $(x + y)^n$

\Rightarrow general term of $\left(x^2 + \frac{1}{x^3}\right)^n$ is

$${}^nC_r \cdot x^{2n-2r} \cdot \frac{1}{x^{3r}} = {}^nC_r \cdot x^{2n-5r}$$

For a term to be independent of x , $2n - 5r$ should be equal to zero, i.e., $2n - 5r = 0$.

$\Rightarrow r = \frac{2}{5}n$, since r can take only integral values, n has to be a multiple of 5.

10. Find the sum of the co-efficient of the terms of the expansion $(1 + x + 2x^2)^6$.

☞ **Solution:** Substituting $x = 1$, we have $(1 + 1 + 2)^6$, which gives us the sum of the co-efficients of the terms of the expansion.

$$\therefore \text{Sum} = 4^6$$

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

- The sum of the first 'n' even natural numbers is
 - $2n^2$
 - $n(n+1)$
 - $n(n+1)^2$
 - $(n+1)^3$
- $n^2 + n + 1$ is a/an _____ number for all $n \in \mathbb{N}$
 - even
 - odd
 - prime
 - None of these
- $1 + 5 + 9 + \dots + (4n-3)$ is equal to
 - $n(4n-3)$
 - $(2n-1)$
 - $n(2n-1)$
 - $(4n-3)^2$
- For all $n \in \mathbb{N}$, which of the following is a factor of $2^{3n} - 1$?
 - 3
 - 5
 - 7
 - None of these
- The smallest positive integer n for which $n! < \frac{(n-1)^n}{2}$ holds is
 - 4
 - 3
 - 2
 - 1
- In the 8th term of $(x+y)^n$, the exponent of x is 3, then the exponent of x in 5th term is
 - 5
 - 4
 - 2
 - 6
- The third term from the end in the expansion of $\left(\frac{4x}{3y} - \frac{3y}{2x}\right)^9$ is
 - ${}^9C_7 \frac{3^5 y^5}{2^3 x^5}$
 - ${}^{-9}C_7 \frac{3^5 y^5}{2^3 x^5}$
 - ${}^9C_7 \frac{3^3 y^5}{2^5 x^3}$
 - None of these
- For what values of n is $14^n + 11^n$ divisible by 5?
 - when n is an even positive integer
 - For all values of n
 - When n is a prime number
 - When n is a odd positive integer
- If the expansion of $\left(x^3 + \frac{1}{x^2}\right)^n$ contains a term independent of x, then the value of n can be
 - 18
 - 20
 - 24
 - 22
- If the third term in the expansion of $\left(x + x^{\log_2 x}\right)^6$ is 960, then the value of x is
 - 2
 - 3
 - 4
 - 8
- If ${}^nC_3 = {}^nC_{15}$, then ${}^{20}C_n$ is
 - 18
 - 380
 - 190
 - 300
- In $(x+y)^n - (x-y)^n$ if the number of terms is 5, then find n.
 - 6
 - 5
 - 10
 - 9
- If the sum of the coefficients in the expansion $(4ax - 1 - 3a^2x^2)^{10}$ is 0 then the value of a can be
 - 2
 - 4
 - 1
 - 7
- Find the coefficient of x^4 in the expansion of $\left(2x^2 + \frac{3}{x^3}\right)^7$.
 - ${}^7C_2 2^5 3^3$
 - ${}^7C_2 2^5 3^2$
 - ${}^7C_2 3^5 2^2$
 - ${}^7C_3 2^5 3^2$
- Find the sum of coefficients of all the terms of the expansion $(ax+y)^n$.
 - ${}^nC_0 a^n + {}^nC_1 a^{n-1} x^{n-1} y + {}^nC_2 a^{n-2} x^{n-2} y^2 + \dots + {}^nC_n y^n$
 - ${}^nC_0 a^n + {}^nC_1 a^{n-1} + {}^nC_2 a^{n-2} + \dots + {}^nC_n$
 - 2^n
 - None of these
- Find the coefficient of the term independent of x in the expansion of $\left(6x^3 - \frac{5}{x^6}\right)^{12}$.
 - ${}^{12}C_4 5^8 6^4$
 - ${}^{12}C_4 5^8 6^3$
 - ${}^{12}C_4 6^8 5^4$
 - ${}^{12}C_4 6^8 5^3$
- In the expansion of $(a+b)^n$, the coefficients of 15th and 11th terms are equal. Find the number of terms in the expansion.
 - 26
 - 25
 - 20
 - 24

18. If ${}^{19}C_r$ and ${}^{19}C_{r-1}$ are in the ratio 2: 3, then find ${}^{14}C_r$.
 (1) 91 (2) 81
 (3) 71 (4) 61
19. If sum of the coefficients of the first two odd terms of the expansion $(x + y)^n$ is 16 then find n.
 (1) 10 (2) 8
 (3) 7 (4) 6
20. The number of terms in the expansion of $[(2x + 3y)^4 (4x - 6y)^4]^9$ is
 (1) 36 (2) 37
 (3) 10 (4) 40
21. If $p(n) = (n - 2)(n - 1)n(n + 1)(n + 2)$, then greatest number which divides $p(n)$ for all $n \in \mathbb{N}$ is
 (1) 12 (2) 24
 (3) 120 (4) None of these
22. $\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \dots + \frac{1}{n(n+1)}$ is equal to
 (1) $\frac{1}{n+1}$ (2) $\frac{n+2}{n(n+1)}$
 (3) $\frac{n+3}{n(n+1)}$ (4) $\frac{n}{n+1}$
23. The inequality $(2n + 7) < (n + 3)^2$ is true for
 (1) All negative numbers.
 (2) All whole numbers.
 (3) All natural numbers.
 (4) None of these
24. For $n \in \mathbb{N}$, $a^{2n-1} + b^{2n-1}$ is divisible by
 (1) $a + b$ (2) $(a + b)^2$
 (3) $a^3 + b^3$ (4) $a^2 + b^2$
25. The greatest number which divides $25^n - 24n - 1$ for all $n \in \mathbb{N}$ is
 (1) 24 (2) 578
 (3) 27 (4) 576
26. Find the coefficient of the independent term in the expansion of $\left(x^{\frac{1}{2}} + 7x^{\frac{1}{3}}\right)^{10}$.
 (1) ${}^{10}C_4 7^4$ (2) ${}^{10}C_6 7^6$
 (3) ${}^{10}C_6 7^5$ (4) ${}^{10}C_4 7^7$
27. Find the term which has the exponent of x as 8 in the expansion of $\left(x^{\frac{5}{2}} - \frac{3}{x^3 \sqrt{x}}\right)^{10}$.
- (1) T_2 (2) T_3
 (3) T_4 (4) Does not exist
28. In the expansion $(1 + x)^n$ if the coefficient of the 8th term is 4 times the coefficient of the 9th term, then find the total number of terms in the expansion.
 (1) 9 (2) 10
 (3) 8 (4) None of these
29. The remainder when $9^{49} + 7^{49}$ is divided by 64 is
 (1) 24 (2) 8
 (3) 16 (4) 38
30. If 'p' and 'q' are the coefficients of x^a and x^b respectively in $(1 + x)^{a+b}$, then
 (1) $2p = q$ (2) $p + q = 0$
 (3) $p = q$ (4) $p = 2q$
31. The number of rational terms in the expansion of $\left(x^{\frac{1}{5}} + y^{\frac{1}{10}}\right)^{45}$ is
 (1) 5 (2) 6
 (3) 4 (4) 7
32. If three consecutive coefficients in the expansion of $(1 + x)^n$, where n is a natural number are 36, 84 and 126 respectively, then n is
 (1) 8 (2) 9
 (3) 10 (4) Cannot be determined
33. $\sum_{r=2}^{16} {}^{16}C_r =$
 (1) $2^{15} - 15$ (2) $2^{16} - 16$
 (3) $2^{16} - 17$ (4) $2^{17} - 17$
34. Find the value(s) of k such that the term independent of x in $\left(3x^2 + \frac{k}{2x}\right)^6$ is 135.
 (1) ± 2 (2) ± 1
 (3) ± 4 (4) ± 3
35. Find the value of $(51)^4$ by using binomial theorem.
 (1) 6765021 (2) 6765201
 (3) 6765211 (4) 6765101
36. Number of non-zero terms in the expansion of $(5\sqrt{5}x + \sqrt{7})^6 + (5\sqrt{5}x - \sqrt{7})^6$ is
 (1) 4 (2) 10
 (3) 12 (4) 14

37. Find the two successive terms in the expansion of $(2 + 3x)^8$ whose coefficients are in the ratio 1: 3.

- (1) 2nd and 3rd terms (2) 3rd and 4th terms
(3) 4th and 5th terms (4) 5th and 6th terms

38. The ratio of the coefficients of x^4 to that of the term independent of x in the expansion of $\left(x^2 + \frac{9}{x^2}\right)^{18}$ is

- (1) 1: 6 (2) 3: 8
(3) 1: 10 (4) 1: 8

39. Find the value of r for which t_{r+1} is the independent term of x in the expansion of $\left(a_1 x^{k_1} + \frac{a_2}{x^{k_2}}\right)^m$.

$$(1) r = \frac{mk_2}{k_1 + k_2} \quad (2) r = \frac{mk_1}{k_1 + k_2}$$

$$(3) r = \frac{mk_1}{k_1 - k_2} \quad (4) r = \frac{mk_2}{k_2 - k_1}$$

40. Find the coefficient of a^3 in the expansion of $\left(\sqrt{a} + \frac{1}{a\sqrt{a}}\right)^{22}$.

$$(1) {}^{22}C_4$$

$$(2) {}^{22}C_6$$

$$(3) {}^{22}C_8$$

$$(4) {}^{22}C_{10}$$

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The sum of the first 'n' odd natural numbers is

- (1) $2n - 1$ (2) $n(2n - 1)$
(3) n^2 (4) n^3

2. $n^2 - n + 1$ is an odd number for all

- (1) $n > 1$
(2) $n > 2$
(3) $n \geq 1$
(4) $n \geq 5$

3. For $n \in \mathbb{N}$, $2^{3^n} + 1$ is divisible by

- (1) 3^{n+11} (2) 3^{n-11}
(3) 3^{n+1} (4) 3^{n+111}

4. $2^n - 1$ gives the set of all odd natural numbers for all $n \in \mathbb{N}$. Comment on the given statement.

- (1) True for all values of n
(2) False
(3) True for only odd values of n
(4) True for only prime values of n

5. The inequality $2^n > n$ is true for

- (1) all whole numbers
(2) all positive integers
(3) all negative integers
(4) all integers

6. In the 5th term of $(x + y)^n$, the exponent of y is 4, then the exponent of y in the 8th term is

- (1) 1 (2) 7
(3) 5 (4) 9

7. The third term from the end in the expansion of $(3x - 2y)^{15}$ is

- (1) ${}^{15}C_{13} 3^{13} 2^2 x^{13} y^2$ (2) ${}^{15}C_{13} 3^{13} 2^2 x^{13} y^2$
(3) ${}^{15}C_2 3^2 2^{13} x^2 y^{13}$ (4) ${}^{15}C_2 3^2 2^{13} x^2 y^{13}$

8. $7^{n+1} + 3^{n+1}$ is divisible by

- (1) 10 for all natural numbers n
(2) 10 for odd natural numbers n
(3) 10 for even natural numbers n
(4) None of these

9. The elements in the fifth row of Pascal triangle is

- (1) 1, 5, 10, 10, 5, 1
(2) 1, 6, 15, 20, 15, 6, 1
(3) 1, 4, 6, 4, 1
(4) 1, 7, 21, 35, 35, 21, 7, 1

10. If the coefficients of 6th and 5th terms of expansion $(1 + x)^n$ are in the ratio 7: 5, then find the value of n .

- (1) 11 (2) 12
(3) 10 (4) 9

11. Find the sixth term in the expansion of $\left(2x^2 - \frac{3}{7x^3}\right)^{11}$.

$$(1) {}^{11}C_5 \frac{2^6 3^5}{7^5} x^3 \quad (2) {}^{11}C_5 \frac{2^6 3^5}{7^5} x^{-3}$$

$$(3) {}^{11}C_5 \frac{2^6 3^5}{7^5} x^{-3} \quad (4) \text{None of these}$$

12. Which term is the constant term in the expansion of $\left(2x - \frac{1}{3x}\right)^6$?
- (1) 2nd term (2) 3rd term
(3) 4th term (4) 5th term
13. The number of terms which are not radicals in the expansion $(\sqrt{7}+4)^6 + (\sqrt{7}-4)^6$, after simplification is
- (1) 6 (2) 5
(3) 4 (4) 3
14. The sum of the coefficients in the expansion of $(x+y)^7$ is
- (1) 119 (2) 64
(3) 256 (4) 128
15. The coefficient of x^4 in the expansion of $\left(4x^2 + \frac{3}{x}\right)^8$ is
- (1) ${}^8C_5 12^5$ (2) ${}^8C_4 12^4$
(3) ${}^8C_3 12^3$ (4) ${}^8C_6 12^6$
16. Find the sum of the coefficients of all the terms in the expansion of $(3x^2 + y)^6$.
- (1) 4096 (2) 4005
(3) 4003 (4) 4004
17. The term independent of x in the expansion of $\left(x^3 - \frac{1}{x^2}\right)^{10}$ is
- (1) ${}^{10}C_6$ (2) ${}^{10}C_7$
(3) ${}^{10}C_9$ (4) ${}^{-10}C_6$
18. If the 20th and 21st terms in the expansion of $(1+x)^{40}$ are equal, then the value of x is
- (1) $\frac{20}{21}$ (2) $\frac{21}{20}$
(3) 25 (4) $\frac{1}{25}$
19. If $11[{}^{n-1}C_3] = 24[{}^nC_2]$, then the value of n is
- (1) 12 (2) 11
(3) 10 (4) 13
20. The sum of the elements in the sixth row of pascal triangle is
- (1) 32 (2) 63
(3) 128 (4) 64
21. The number of factors of the greatest number that divides any number of the form $p(n)$ where $p(n) = n(n+1)(n+2)(n+3)(n+4)(n+5)$ is
- (1) 10 (2) 20
(3) 30 (4) 40
22. $\frac{2}{3} + \frac{2}{15} + \frac{2}{35} + \dots + \frac{2}{(2n-1)(2n+1)}$ is equal to
- (1) $\frac{2n}{2n-1}$ (2) $\frac{2n}{2n+1}$
(3) $\frac{2n}{2n-3}$ (4) $\frac{2n}{2n+3}$
23. $2 \cdot 3^{n+1} + 3 \cdot 2^{n-1}$ (where $n \in \mathbb{N}$) is divisible by
- (1) 2 (2) 3
(3) 6 (4) 7
24. For all $n \in \mathbb{N}$, $x^n + 1$ is divisible by
- (1) $x+1$
(2) $x-1$
(3) Both (1) and (2)
(4) None of these
25. For all $n \in \mathbb{N}$, $41^n - 40n - 1$ is divisible by
- (1) 41 (2) 40
(3) 300 (4) 500
26. Find the number of terms of the expansion $(1-x^2+y^3)^5$.
- (1) 15 (2) 6
(3) 21 (4) 81
27. Find the coefficient of x^9 in the expansion of $\left(11x^2 + \frac{3}{x^5}\right)^{15}$.
- (1) ${}^{15}C_{12} 11^{13} 3^{12}$ (2) ${}^{15}C_3 11^{10} 3^5$
(3) ${}^{15}C_3 3^2 11^3$ (4) ${}^{15}C_{12} 11^{12} 3^3$
28. Find the independent term in the expansion of $\left(2x^2 + \frac{7}{x^5}\right)^{10}$.
- (1) ${}^{10}C_2 2^{87} 2$ (2) ${}^{10}C_3 2^{77} 3$
(3) ${}^{10}C_8 2^{87} 3$ (4) Does not exist.
29. If sum of the first 3 coefficients is 16 in the expansion $\left(x + \frac{1}{x^3}\right)^n$, then find n .
- (1) 10 (2) 8
(3) 5 (4) 4

30. The value of middle term in the expansion of $(100 - 2)^4$ by using the binomial theorem is
 (1) -240000 (2) 240000
 (3) -3200 (4) 3200
31. Find the coefficient of the term which contains the 10th power of x in the expansion of $\left(x^{\frac{1}{3}} + \frac{1}{x^{\frac{1}{3}}}\right)^{40}$.
 (1) 870 (2) 680
 (3) 780 (4) None of these
32. If m and n are the coefficients of x^{a^2} and x^{b^2} respectively in $(1+x)^{a^2+b^2}$, then
 (1) $n = 2m$ (2) $m + n = 0$
 (3) $2n = m$ (4) $m = n$
33. The number of rational terms in the expansion of $\left(x^{\frac{1}{2}} + y^{\frac{1}{3}}\right)^{18}$ is
 (1) 5 (2) 2
 (3) 3 (4) 4
34. If three consecutive coefficients in the expansion of $(1+x)^n$ are 495, 220 and 66 respectively, then n =
 (1) 15 (2) 12
 (3) 13 (4) 14
35. Find the coefficient of x^7 in the expansion of $\left(7x + \frac{2}{x^2}\right)^{13}$.
- (1) $78 \times 8^8 \times 4$ (2) $78 \times 7^6 \times 4^2$
 (3) $78 \times 7^{11} \times 4$ (4) $78 \times 7^{11} \times 4^2$
36. Find the two successive terms in the expansion of $(3+4x)^7$ whose coefficients of x are in the ratio 1: 1.
 (1) T_5, T_6 (2) T_3, T_4
 (3) T_4, T_5 (4) Does not exist
37. Find the value of k for which the term independent of x in $\left(x^2 + \frac{k}{x}\right)^{12}$ is 7920.
 (1) $\frac{1}{\sqrt{2}}$ (2) $\frac{1}{2}$
 (3) $\sqrt{2}$ (4) 2
38. If the coefficients of x in the 4th and 7th terms of the expansion $(1+x)^n$ are in the ratio 4: 7, then find n
 (1) 8 (2) 9
 (3) 12 (4) 10
39. The total number of terms in the expansion of $(x+y)^{50} + (x-y)^{50}$ is
 (1) 51
 (2) 26
 (3) 102
 (4) 25
40. The value of $(\sqrt{5}+2)^6 + (\sqrt{5}-2)^6$ is
 (1) a positive integer
 (2) a negative integer
 (3) an irrational number
 (4) a rational number but not an integer

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 3 | 4. 3 | 5. 1 | 6. 4 | 7. 2 | 8. 4 | 9. 2 | 10. 1 |
| 11. 3 | 12. 4 | 13. 3 | 14. 2 | 15. 2 | 16. 3 | 17. 2 | 18. 1 | 19. 4 | 20. 2 |
| 21. 3 | 22. 4 | 23. 2 | 24. 1 | 25. 4 | 26. 2 | 27. 4 | 28. 2 | 29. 3 | 30. 3 |
| 31. 1 | 32. 2 | 33. 3 | 34. 1 | 35. 2 | 36. 1 | 37. 2 | 38. 3 | 39. 2 | 40. 1 |

PRACTICE EXERCISE 11 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 3 | 4. 2 | 5. 4 | 6. 2 | 7. 4 | 8. 3 | 9. 1 | 10. 1 |
| 11. 3 | 12. 3 | 13. 3 | 14. 4 | 15. 2 | 16. 1 | 17. 1 | 18. 1 | 19. 2 | 20. 4 |
| 21. 3 | 22. 2 | 23. 2 | 24. 4 | 25. 2 | 26. 3 | 27. 4 | 28. 4 | 29. 3 | 30. 2 |
| 31. 3 | 32. 4 | 33. 4 | 34. 2 | 35. 3 | 36. 4 | 37. 3 | 38. 4 | 39. 2 | 40. 1 |

Commercial Mathematics

SYNOPSIS

- **Percentage:** Percentage means 'for every hundred'.

$$\frac{1}{2} = \frac{50}{100} = 50\% ; \frac{1}{3} = \frac{33.3}{100} = 33.3\%.$$

Percentage points is the difference between two percentages. It is not equal to either percentage increase or percentage decrease.

- **Profit:** Profit = selling price – cost price.

Percentage of profit is always calculated on the cost price of the article.

When $SP > CP$;

- (i) Profit = $SP - CP$
- (ii) $SP = CP + \text{Profit}$
- (iii) $CP = SP - \text{Profit}$
- (iv) Profit Percentage = $\frac{\text{Profit}}{CP} (100)\%$
- (v) When CP and Profit Percentage are given,

$$SP = (CP) \left(\frac{100 + \text{Profit Percentage}}{100} \right)$$

Loss = cost price – selling price.

Percentage of loss is always calculated on the cost price of the article.

When $SP < CP$,

- (i) Loss = $CP - SP$
- (ii) $SP = CP - \text{Loss}$

$$(iii) \quad CP = \text{Loss} + SP$$

$$(iv) \quad \text{Loss Percentage} = \frac{\text{Loss}}{CP} \times 100\%$$

- (v) When CP and Loss Percentage are given,

$$SP = CP \left(\frac{100 - \text{Loss Percentage}}{100} \right)$$

- **Partnership:** The total amount of money required to start a business is called its **capital**. It is not always possible for a single person to invest huge amounts. So, two or more persons come together and start the business jointly. Such business which is undertaken jointly is called **partnership**. The people who run the business jointly are called **partners** and the money invested by them in the business is called **investment**.

Types of Partnership

- (i) In general partnership, the period of investment is the same and the partners divide profit or loss in the ratio of their investments.
- (ii) In compound partnership, the investments and the periods of investment differ. Then their investments reduce to investments per month or year and the profit or loss is divided in the ratio of these converted investments.

○ **Simple interest** = $\frac{Pnr}{100}$

Total Amount (A) = $P + \frac{Pnr}{100} = P \left(1 + \frac{nr}{100} \right)$

○ **Compound interest** = $P \left(1 + \frac{R}{100} \right)^n - P$, where P is

principal, R is the rate of interest per period and n is the number of periods interest is calculated.

- **Calculation of interest on Savings Accounts in Banks:** The monthly minimum balances (**Minimum balance** is the least of all the balances left in the account from the 10th to the last day of that month) from January to the end of June are added and this total amount is called the '**product**' in Banks. Interest is calculated on this product and added to the opening balance on 1st July. In the same way, the interest for the next half year is calculated and is added to the opening balance on 1st January. In savings account, interest is calculated as per the following steps.

- (1) The least of the balances from the 10th day of a month to the last day of the month is taken as the balance for the month.
- (2) The sum of all these monthly balances is taken as the principle for calculating interest.

(3) Interest = $\frac{\text{Principal} \times \text{Rate of interest}}{12 \times 100}$.

- **Calculation of interest on Recurring Deposit Accounts:** If a man deposits 'k per month and for n months at R% p.a, then

Simple interest = $\text{₹} \left[k \times \frac{n(n+1)}{2} \times \frac{1}{12} \times \frac{R}{100} \right]$.

- **Calculation of interest on loans:** Interest on loans is calculated on daily product basis once in every

quarter, the loan amount is increased by that amount. Daily product = Balance \times Number of days it has remained as balance.

Interest = $\frac{\text{Sum of daily products} \times \text{Rate}}{100 \times 365}$

Important Features of Hire Purchase Scheme

- (1) The hirer pays an initial payment known as down payment.
- (2) The vendor allows the hirer to take possession of the goods on the date of signing the agreement, but he does not transfer the ownership of the goods.
- (3) The hirer promises to pay the balance amount in instalments.
- (4) If the hirer fails to pay the instalments the vendor can repossess the goods.
- (5) When goods are repossessed, the hirer cannot ask for the repayment of the instalments of money already paid. This money paid will be treated as rent for the period.

Instalment Scheme: Under the instalment scheme the seller transfers the possession as well as the ownership of the goods to the buyer. The buyer has the right to resell, pledge the goods, but he has to repay the instalments due.

- **Calculating the rate of interest on buying in instalment scheme:** The formula that is used to calculate the rate of interest on instalment buying is

$$R = \frac{2400E}{n[(n+1)I - 2E]}$$

R = Rate of interest; E = Excess amount paid

n = Number of instalments; I = Amount of each instalment. E = Down payment + Sum of instalment amounts – Cash price.

Solved Examples

1. What percentage of 3.6 km is 360 metres?

☞ **Solution:** We know that 1 km = 1000 metres

$$\Rightarrow 3.6 \text{ km} = 3.6 \times 1000 = 3600 \text{ metres}$$

$$\therefore \text{The required percentage} = \left(\frac{360}{3600} \times 100 \right) \% \\ = 10\%.$$

2. Find the number, 30% of which is 36.

☞ **Solution:** Let the number be x.

Given that 30% of the number is 36.

$$\Rightarrow 30\% \text{ of } x = 36 \Rightarrow \frac{30}{100} \times x = 36$$

$$\Rightarrow x = \frac{36 \times 100}{30} \Rightarrow x = 120$$

\therefore The required number is 120.

3. If Anil's salary is 20% less than Raju's salary, then by what percentage is Raju's salary more than that of Anil?

☺ **Solution:** Let Raju's salary be ₹100.

Anil's salary is 20% less than Raju's salary.

⇒ Salary of Anil = 80% of 100 = ₹80

Raju's salary is ₹20 more than that of Anil's.

⇒ Now, the required percentage = $\frac{20}{80} (100)\%$
= 25%

∴ Raju's salary is 25% more than Anil's salary.

4. Mohit's weight is 40 kg and Rohan's weight is 35 kg. By what percentage is Rohan's weight less than that of Mohit?

☺ **Solution:** $\left(\frac{40 - 35}{40} \right) (100)\% = 12.5\%$

Note: When a quantity changes from time to time, we find percentage change in the quantity.

For example, the price of an article is ₹20 in the year 2005 and it became ₹24 in the year 2006.

The percentage in change in the article is $\frac{4}{20} \times 100 = 20\%$ increase.

Percentage change can be defined as
$$\frac{\text{final value} - \text{initial value}}{\text{initial value}} \times 100.$$

Percentage change could be increase or decrease.

5. In an examination, Mohit secured 60% of the maximum marks, which is more than the pass marks by 45 marks. Find the maximum marks in the examination if the pass mark is 45%.

☺ **Solution:** Marks secured by Mohit = 60%. Pass mark = 45%

Difference between the marks secured and pass mark = $(60 - 45)\% = 15\%$

Given that Mohit got 45 marks more than the pass marks.

Let the maximum marks be x.

⇒ 15% of x = 45 ⇒ $x = \frac{45 \times 100}{15} = 300$

∴ The maximum marks in the examination = 300.

6. A shopkeeper bought a cycle for ₹1200 and sold it for ₹1500. Find his profit (or) loss percentage.

☺ **Solution:** Cost price of the cycle = ₹1200

Selling price of the cycle = ₹1500

SP > CP ⇒ there is a gain.

⇒ Gain = SP - CP = 1500 - 1200 = ₹300

∴ Gain Percentage = $\frac{\text{Gain}}{\text{CP}} (100)\%$
= $\frac{300}{1200} (100)\% = 25\%$

∴ The shopkeeper makes a profit of 25%

7. Rakesh purchased a TV for ₹5000 and paid ₹250 for its transportation. If he sold the TV for ₹5075, find his profit or loss percentage.

☺ **Solution:** Price at which TV was bought = ₹5000

Overheads in the form of transportation = ₹250

∴ The total cost price of the TV = $(5000 + 250)$
= ₹5250

Selling price of the TV = ₹5075

SP < CP ⇒ There is a loss and loss = CP - SP = 5250 - 5075 = ₹175.

∴ loss percentage = $\frac{\text{Loss}}{\text{CP}} (100)\% = \frac{175}{5250} (100)\%$
= $\frac{10}{3} \% = 3.33\%$

∴ Rakesh incurred a loss of 3.33%

8. By selling 24 pens, Kranthi lost an amount equal to the CP of 3 pens. Find his loss percentage.

☺ **Solution:** Let us assume that cost price of each pen is Re1

⇒ CP of 24 pens = ₹24

Loss = CP of 3 pens = $3 \times 1 = ₹3$

⇒ Loss Percentage = $\left(\frac{\text{Loss}}{\text{CP}} \times 100 \right) \%$
= $\frac{3}{24} \times 100\% = 12.5\%$

∴ Kranthi's loss is 12.5%

PRACTICE EXERCISE 12 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Ramu marked his bicycle at ₹800. He sold it without offering any discount. The price at which he bought it was ₹500. Find his profit percentage.
 - (1) 60
 - (2) 80
 - (3) 50
 - (4) 30
2. Sohan bought 16 kg of sugar for a total of ₹360. He sold it at a profit equal to the selling price of 4 kg of it. Find his selling price (in ₹/kg).
 - (1) 45
 - (2) 60
 - (3) 90
 - (4) 30
3. A number when increased by 30% becomes 78. Find the number.
 - (1) 60
 - (2) 70
 - (3) 40
 - (4) 48
4. The ratio of two numbers is $\frac{5}{6} : \frac{2}{3}$. By what percentage is the second number more/less than the first number?
 - (1) 20% less
 - (2) 25% more
 - (3) 25% less
 - (4) 20% more
5. If 30% of $x = 60\%$ of 96, then find the value of x .
 - (1) 384
 - (2) 192
 - (3) 48
 - (4) 24
6. If X is 20% more than Y , then find 120% of Y in terms of X .
 - (1) $\frac{X}{2}$
 - (2) $2X$
 - (3) X
 - (4) $\frac{X}{6}$
7. In a test, Arun got 20% and failed by 10 marks. Bala got 40% in the same test and got 10 marks more than the pass mark. Find the maximum marks.
 - (1) 400
 - (2) 300
 - (3) 200
 - (4) 100
8. A dealer purchases 15 articles for ₹25 and sells 12 articles for ₹30. Find the profit percentage.
 - (1) 50%
 - (2) 40%
 - (3) 20%
 - (4) 10%
9. X sells an article to Y at 15% profit. Y sells it to Z at 10% profit. What is X 's cost price, if Y makes a profit of ₹23? (In ₹)
 - (1) 200
 - (2) 180
 - (3) 150
 - (4) 120
10. In a certain season, the Indian cricket team had a 25% success rate in the first 40 matches it played. What is the minimum number of additional matches it must play so that it has a $66\frac{2}{3}\%$ success rate for the season?
 - (1) 40
 - (2) 50
 - (3) 60
 - (4) 80
11. A man sells two scooters at ₹36000 each. On one scooter he makes 15% profit and on the other he makes 15% loss. Find the profit or loss percentage in the whole transaction.
 - (1) 2.25% loss
 - (2) 2.25% profit
 - (3) 22.5% loss
 - (4) 22.5% profit
12. A dishonest trader claims that he sells his goods at the cost price, but weighs 900 gm for every kg that he sells. Find his profit percentage.
 - (1) $9\frac{1}{11}\%$
 - (2) 10%
 - (3) $11\frac{1}{9}\%$
 - (4) 12.5%
13. The difference between S.I. and C.I. (compounded annually) on a sum of ₹64000 for 2 years is ₹1000. What is the rate of interest per annum?
 - (1) 25%
 - (2) $16\frac{2}{3}\%$
 - (3) $13\frac{1}{3}\%$
 - (4) $12\frac{1}{2}\%$
14. An article can be sold for ₹20000 cash or for ₹12000 down payment and 4 equal monthly instalments of ₹2200 each. Find the interest paid (In ₹).
 - (1) 400
 - (2) 600
 - (3) 800
 - (4) 1000
15. A computer is sold by a company for ₹20000 cash or ₹8000 down payment followed by 5 equal monthly instalments of ₹2500 each. Find the total principal on which the interest is charged to realize the total interest in a month (In ₹).

- (1) 35000 (2) 36000
(3) 38000 (4) 40000
16. Javed makes a fixed deposit of ₹100000 in a bank for one year. If the rate of interest is 6% per annum, compounded half-yearly, then find the maturity value (In ₹).
(1) 106090 (2) 105000
(3) 104060 (4) 104000
17. A sum of money at simple interest amounts to ₹800 in 2 years and to ₹1200 in 6 years. The sum is
(1) ₹600 (2) ₹1000
(3) ₹400 (4) ₹500
18. A sum of money invested at compound interest doubles itself in six years. In how many years will it become 64 times itself at the same rate of compound interest?
(1) 30 (2) 36
(3) 42 (4) 48
19. The integral number of years in which a sum of money at 25% p.a. under compound interest will become more than twice itself, is at least.
(1) 3 (2) 2
(3) 4 (4) 1
20. A double cot is available for ₹13000 cash or for ₹1300 down payment followed by four equal monthly instalments of ₹3000 each. Find the principal for the third month, if interest charged under simple interest is (in ₹).
(1) 5200 (2) 4900
(3) 6200 (4) 5700
21. The difference between the compound interest and simple interest on a certain sum at 12% per annum for 2 years is ₹126.72. Find the sum (in ₹).
(1) 8000 (2) 8800
(3) 10200 (4) 12400
22. The compound interest earned in the third and the fourth years on a certain sum of money are ₹576 and ₹691.2. Find the sum (in ₹).
(1) 1000 (2) 1200
(3) 1600 (4) 2000
23. A man borrowed Rs.25000 from a bank at 20% compound interest. At the end of every year he paid ₹8000. At the end of the third year, he wanted to clear the loan. How much should he pay to clear the loan?
- (1) ₹12400 (2) ₹16040
(3) ₹20800 (4) ₹22080
24. Find the present worth of ₹1749.6 due in 2 years at 8% per annum compound interest (in ₹).
(1) ₹1200 (2) ₹1400
(3) ₹1500 (4) ₹1650
25. A sum of money compounded annually amounts to ₹1375 in 5 years and ₹1980 in 7 years. Find the annual rate of interest.
(1) 12% (2) 20%
(3) 15% (4) 10%
26. In how many years will a sum of money become sixteen times itself at 30% p.a. simple interest?
(1) 40 (2) 50
(3) 60 (4) 70
27. A sum becomes three times itself at compound interest in eight years. In how many years will the sum become twenty seven times itself?
(1) 24 (2) 20
(3) 18 (4) 10
28. A man borrows ₹80,000 at 15% p.a. simple interest. He repays ₹48,000 at the end of first year and the balance at the end of second year. What amount did he repay at the end of the second year (in ₹)?
(1) 24600 (2) 36200
(3) 48800 (4) 52500
29. A certain sum is lent at compound interest for three years. The rate of interest for the three years are 5%, 8% and 10% respectively. If the amount at the end of three years is ₹1,247.40, find the sum (in ₹).
(1) 1000 (2) 1050
(3) 1080 (4) 1100
30. The value of an old bike decreases every year at the rate of 4% over that of the previous year. If its value at the end of three years is ₹13824, then find its present value.
(1) ₹15625
(2) ₹14525
(3) ₹16625
(4) ₹15425
31. A student secured 80% of the total marks and got 720 marks. How many marks did a student who scored 90% get?
(1) 770 (2) 810
(3) 900 (4) 990

32. An article is marked 20% over the cost. A discount of 8% is offered on the marked price of the article. What is profit percentage in selling the article?
 (1) 6.8% (2) 8.2%
 (3) 9.6% (4) 10.4%
33. A trader professes to sell his goods at cost price and still earns a profit of $33\frac{1}{3}\%$. What weight does he use for every kilogram (in grams)?
 (1) $333.\bar{3}$ (2) 600
 (3) 666.6 (4) 750
34. A certain sum is lent at compound interest for three years at rate of interests of 5%, 10% and 12% respectively for three consecutive years. Find the sum if the total interest for the three years is ₹5284.80 (in ₹).
 (1) 18000 (2) 16000
 (3) 15000 (4) 12000
35. How much more does a man get by investing ₹40,000 at 40% p.a. compound interest, compounded half yearly, than at 40% p.a. compound interest, compounded yearly per one year?
 (1) 1000
 (2) 1200
 (3) 1500
 (4) 1600

PRACTICE EXERCISE 12 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- What percentage of 840 is 180?
 (1) $22\frac{6}{7}\%$ (2) $23\frac{4}{7}\%$
 (3) $24\frac{2}{7}\%$ (4) $21\frac{3}{7}\%$
- 32% of what number is 256?
 (1) 1024 (2) 800
 (3) 640 (4) 400
- Which of the following fraction equals $101\frac{3}{5}\%$?
 (1) $508/5$ (2) $254/5$
 (3) $51/25$ (4) $127/125$
- If 60% of x is 60 more than 60% of 60, then 60% of x = _____.
 (1) 90 (2) 94
 (3) 96 (4) 92
- If 60% of 70% of a number is 1680, find the number.
 (1) 2000 (2) 3000
 (3) 4000 (4) 5000
- In a test, P got 150 marks and Q got 120 marks. What percentage of P's mark was Q's mark?
 (1) 80% (2) 75%
 (3) 60% (4) 65%
- If a% of b + b% of a is equal to $33\frac{1}{3}\%$ of (a + b), then find the value of $\left(\frac{1}{a} + \frac{1}{b}\right)$
- A man sells two articles at the same selling price - one at 25% profit and other at 25% loss. What is the overall profit or loss percentage?
 (1) 10% (2) 5%
 (3) 6.25% (4) 12.5%
- A sum amounts to nineteen times itself in five years under simple interest. In how many months will the same sum become four times itself?
 (1) 10 (2) 12
 (3) 15 (4) 18
- Find the difference between the simple interest and the compound interest for two years on a sum of ₹28,000 at 25% p.a. rate of interest (in ₹).
 (1) 1750 (2) 2000
 (3) 2250 (4) 3000
- In what time will a sum become three times itself at 20% per annum, at simple interest?
 (1) 8 years (2) 10 years
 (3) 15 years (4) 20 years
- Find the compound interest on ₹5000 at 10% per annum for 1 year, interest compounded annually.
 (1) ₹400 (2) ₹250
 (3) ₹1000 (4) ₹500

13. A water filter is available for ₹500 down payment followed by two instalments of ₹600 each. If the total interest paid is ₹100, then what is the cash price of the water filter?
- (1) ₹1600 (2) ₹1700
(3) ₹1500 (4) ₹1400
14. A mobile phone is available for a cash price of ₹1200 or for a certain down payment followed by three equal instalments of ₹300 each. The total interest paid is ₹100 when bought under the instalment scheme. How much is the down payment for the mobile phone?
- (1) ₹800 (2) ₹450
(3) ₹350 (4) ₹400
15. A car is available for ₹200000 cash or ₹50000 down payment followed by 16 equal monthly instalments. If the total interest charged in this scheme is ₹10000, how much is each monthly instalment?
- (1) ₹16000 (2) ₹10000
(3) ₹13000 (4) ₹20000
16. Find the annual income derived from an investment of ₹18000 in ₹150 shares available at ₹180 of a company paying 11% dividend.
- (1) 1500 (2) 1650
(3) 1750 (4) 1800
17. The difference between the C.I. and S.I. on a sum of ₹7200 for two years is ₹72. Find the rate of interest per annum.
- (1) 10% (2) 12%
(3) 15% (4) 20%
18. A washing machine is available for ₹9000 cash or 45% down payment and 3 equal monthly instalments. Each instalment is 20% of the cash payment. What is the approximate annual rate of interest?
- (1) 56% (2) 57%
(3) 58% (4) 59%
19. Srija makes a fixed deposit of ₹125000 with a bank. The bank pays interest at 8% per annum compounded annually and she received ₹157464 at the time maturity. Find the time period for which she held account (in years).
- (1) 1 (2) 2
(3) 3 (4) 4
20. Tilak opened a recurring deposit account with a bank and deposited ₹600 per month for one year. Find the interest that Tilak will receive, if the bank pays 6% per annum (in ₹).
- (1) 312 (2) 234
(3) 624 (4) 468
21. Anand paid ₹30 as sales tax on a bottle of mineral water with marked price as ₹400. Calculate the rate of sales tax.
- (1) 15% (2) 12.5%
(3) 6% (4) 7.5%
22. A sum triples itself in three years at simple interest. In how many years will the same sum become nine times itself at the same rate?
- (1) 18 (2) 9
(3) 12 (4) 27
23. A sum is split into two equal parts. One of the parts is lent at simple interest at 20% p.a. for 6 years. The other part is lent at 40% p.a. simple interest for 2 years. The difference in the interests is ₹72. Find the total sum (in ₹).
- (1) 180 (2) 240
(3) 300 (4) 360
24. ₹60000 is invested in buying ₹120 shares of a company which are available at a premium of 25%. Find the number of shares bought and the annual rate of return on the investment, if the dividend is paid at the rate of 10% per annum.
- (1) 8% (2) 10%
(3) 12% (4) 15%
25. A man borrows ₹10500 from a finance company and repays it in two equal annual instalments. If the rate of interest being compounded annually is 10% p.a., then find the value of each instalment. (in ₹)
- (1) 6000 (2) 6050
(3) 6100 (4) 6150
26. What would a sum of ₹8800 amount to in 16 years at a simple interest rate of 12% every year (in ₹)?
- (1) 14440 (2) 18846
(3) 25696 (4) 32322
27. A sum of money invested at simple interest amounts to ₹2480 at the end of four years and ₹4080 at the end of eight years. Find the principal (in ₹).
- (1) ₹2040 (2) ₹1480
(3) ₹1240 (4) ₹880

28. A certain loan amounts, under compound interest, compounded annually earns an interest of ₹1980 in the second year and ₹2178 in the third year. How much interest did it earn in the first year (in ₹)?
 (1) 1600 (2) 1800
 (3) 1900 (4) 2000
29. The difference between the interest earned under compound interest, interest being compounded annually and simple interest for two years on the same sum and at the same rate of interest is ₹25.60. Find the sum if the rate of interest is 8% p.a (in ₹).
 (1) 2000 (2) 2500
 (3) 3200 (4) 4000
30. A sum of money under compound interest doubles itself in 4 years. In how many years will it become 16 times itself?
 (1) 12 (2) 16
 (3) 8 (4) 6
31. Raju took a loan at 8% per annum simple interest for a period of 5 years. At the end of five years he paid ₹10640 to clear his loan. How much loan did he take (in ₹)?
 (1) 8500 (2) 8000
 (3) 7700 (4) 7600
32. What annual installment will discharge a debt of ₹1815 due in 3 years at 10% simple interest (in ₹)?
 (1) 500 (2) 520
 (3) 550 (4) 580
33. Under simple interest, due to the fall in the interest rate by 0.5 percentage point my yearly income from savings come down by ₹884. Find the savings (in ₹).
 (1) 80400 (2) 112000
 (3) 176800 (4) 224000
34. Find the amount obtained by investing ₹24,000 at 18% p.a. simple interest for five years.
 (1) ₹21,600 (2) ₹44,000
 (3) ₹45,600 (4) ₹48,000
35. Find the amount obtained by investing ₹20,000 at 10% p.a. compound interest for two years, compounded annually.
 (1) ₹22,000 (2) ₹24,000
 (3) ₹26,000 (4) ₹24,200

ANSWER KEYS

PRACTICE EXERCISE 12 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 4 | 3. 1 | 4. 1 | 5. 2 | 6. 3 | 7. 4 | 8. 1 | 9. 1 | 10. 2 |
| 11. 1 | 12. 3 | 13. 4 | 14. 3 | 15. 1 | 16. 1 | 17. 1 | 18. 2 | 19. 3 | 20. 4 |
| 21. 2 | 22. 4 | 23. 4 | 24. 3 | 25. 2 | 26. 2 | 27. 1 | 28. 3 | 29. 1 | 30. 1 |
| 31. 2 | 32. 4 | 33. 4 | 34. 1 | 35. 4 | | | | | |

PRACTICE EXERCISE 12 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 4 | 4. 3 | 5. 3 | 6. 1 | 7. 2 | 8. 3 | 9. 1 | 10. 1 |
| 11. 2 | 12. 4 | 13. 1 | 14. 4 | 15. 2 | 16. 2 | 17. 1 | 18. 2 | 19. 3 | 20. 2 |
| 21. 4 | 22. 3 | 23. 4 | 24. 1 | 25. 2 | 26. 3 | 27. 4 | 28. 2 | 29. 4 | 30. 2 |
| 31. 4 | 32. 3 | 33. 3 | 34. 3 | 35. 4 | | | | | |

Progressions

SYNOPSIS

- **Sequence:** A systematic arrangement of numbers according to a given rule is called a sequence.
- **Series:** The sum of the terms of a sequence is called the series of the corresponding sequence.

Note: $1 + 2 + 3 + \dots + n$ is a finite series of first n natural numbers.

The sum of first n terms of series is denoted by S_n .

$$\text{Here, } S_n = T_1 + T_2 + \dots + T_{n-1} + T_n$$

$$S_{n-1} = T_1 + T_2 + T_3 + \dots + T_{n-1}$$

$$\Rightarrow S_n - S_{n-1} = T_n$$

Arithmetic Progression: Numbers (or terms) are said to be in arithmetic progression when each term except the first term is obtained by adding a constant to the previous number (or term).

Let the first term of the progression be a and the common difference be d .

(i) The n^{th} term (general term) is $T_n = a + (n - 1)d$

(ii) The sum to n terms, $S_n = \frac{n}{2} [2a + (n - 1)d]$

The sum to n terms can also be written in a different manner. That is, the sum of n terms

$$= \frac{n}{2} [2a + (n - 1)d]$$

$$= \frac{n}{2} [a + \{a + (n - 1)d\}]$$

But, when there are n terms in an AP a is the first term and $\{a + (n - 1)d\}$ is the last term.

$$\text{Hence, } S_n = \left(\frac{n}{2}\right) [\text{first term} + \text{last term}]$$

- **Arithmetic Mean (AM):** The average of all the terms in an AP is called the arithmetic mean of the AP.

The average of a certain numbers =

$$\frac{\text{The sum of all the numbers}}{\text{The number of numbers}}$$

\therefore A.M. of n terms in an

$$AP = \frac{S_n}{n} = \frac{1}{n} \times \frac{n}{2} [\text{first term} + \text{last term}]$$

Note:

1. In general, the average of the k^{th} term from the beginning and the k^{th} term from the end is equal to the AM of the AP. If the AM of an AP is known, the sum to n terms of the series (S_n) can be expressed as $S_n = n (\text{AM})$
2. If a and b are any two numbers, then their
$$AM = \frac{a + b}{2}.$$

- **Inserting arithmetic mean between two numbers:**

When n arithmetic means a_1, a_2, \dots are inserted between a and b , then $a, a_1, a_2, \dots, a_n, b$ are in AP

$\therefore a = t_1$ and $b = t_{n+2}$. Let d be the common difference.

$$\Rightarrow b = t_1 + (n+1)d \Rightarrow b = a + (n+1)d$$

$$\Rightarrow d = \frac{(b-a)}{(n+1)}$$

Note:

- If three numbers are in AP we can take the three terms to be $(a-d)$, a and $(a+d)$.
- If four numbers are in AP we can take the four terms to be $(a-3d)$, $(a-d)$, $(a+d)$ and $(a+3d)$. The common difference in this case is $2d$ and not d .
- If five numbers are in AP we can take the five terms to be $(a-2d)$, $(a-d)$, a , $(a+d)$ and $(a+2d)$.

Some Important Results

- The sum of first n natural numbers =

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}$$
 - The sum of the squares of first n natural numbers

$$= \sum_{i=1}^n i^2 = \frac{n(n+1)(2n+1)}{6}$$
 - The sum of the cubes of first n natural numbers

$$= \sum_{i=1}^n i^3 = \left[\frac{n(n+1)}{2} \right]^2 = \frac{n^2(n+1)^2}{4} = \left[\sum_{i=1}^n i \right]^2$$
- **Geometric Progression:** Numbers are said to be in geometric progression when the ratio of any quantity to the number that follows it is the same. In other words, any term of a GP (except the first one) can be obtained by multiplying the previous term by the same constant. The constant is called the common ratio and is normally represented by r . The first term of a GP is generally denoted by a .
- A geometric progression can be represented by a, ar, ar^2, \dots where a is the first term and r is the common ratio of the GP. n^{th} term of the GP is ar^{n-1} i.e., $t_n = ar^{n-1}$
 - The sum to n terms, $S_n = \frac{a(r^n - 1)}{r - 1} = \frac{r(ar^{n-1}) - a}{r - 1}$
 \therefore The sum to n terms of a geometric progression can also be written as

$$S_n = \frac{r(\text{Last term}) - \text{First term}}{r - 1}$$
 - If n terms viz., $a_1, a_2, a_3, \dots, a_n$ are in GP then the geometric mean (GM) of these n terms is given by $= \sqrt[n]{a_1 a_2 a_3 \dots a_n}$.

(iv) If three terms are in geometric progression, then the middle term is the geometric mean of the GP, i.e., if a, b and c are in GP then b is the geometric mean of the three terms.

(v) If there are two terms say a and b , then their geometric mean is given by $GM = \sqrt{ab}$.

(vi) When n geometric means are there between a and b , the common ratio of the GP can be derived as follows.

Given that, n geometric means are there between a and b . $\therefore a = t_1$ and $b = t_{n+2}$

Let ' r ' be the common ratio $\Rightarrow b = (t_1)(r^{n+1})$

$$\Rightarrow b = a r^{n+1} \Rightarrow r^{n+1} = \frac{b}{a} \Rightarrow r = \sqrt[n+1]{\frac{b}{a}}$$

Infinite Geometric Progression

If $-1 < r < 1$ (or $|r| < 1$). The sum of an infinite geometric progression is represented by S_∞ and is given by the formula, $S_\infty = \frac{a}{1-r}$, if $|r| < 1$.

○ **Harmonic Progression (HP):** A series is said to be a harmonic progression if the reciprocals of the terms in the progression form an arithmetic progression.

n^{th} term of an HP: We know that if $a, a+d, a+2d, \dots$ are in AP, then the n^{th} term of this AP is $a + (n-1)d$.

So, n^{th} term of an HP is $\frac{1}{a + (n-1)d}$.

Note: There is no concise general formula for the sum to n terms of an HP.

Harmonic Mean (HM): If three terms are in HP then the middle term is the HM of other two terms. The harmonic mean of two terms a and b is given by

$$HM = \frac{2ab}{a+b}$$

Inserting n Harmonic Means between Two Numbers

To insert n harmonic means between two numbers, we first take the corresponding arithmetic series and insert n arithmetic means, and next, we find the corresponding harmonic series.

Relation between AM, HM and GM of Two Numbers

Let x and y be two numbers

$$\therefore AM = \frac{x+y}{2}, GM = \sqrt{xy} \text{ and } HM = \frac{2xy}{x+y}$$

$$\Rightarrow (AM)(HM) = (GM)^2$$

Solved Examples

1. In a series, $T_n = 2n + 5$, find S_4 .

☞ **Solution:** $T_n = 2n + 5$

$$T_1 = 2(1) + 5 = 7; T_2 = 2(2) + 5 = 9$$

$$T_3 = 2(3) + 5 = 11; T_4 = 2(4) + 5 = 13$$

$$S_4 = T_1 + T_2 + T_3 + T_4 = 7 + 9 + 11 + 13 = 40.$$

2. Find the first term and the common difference of an AP if the 3rd term is 6 and the 17th term is 34.

☞ **Solution:** If a is the first term and d is the common difference, then we have $a + 2d = 6$... (1)

$$a + 16d = 34 \quad \dots (2)$$

On subtracting equation (1) from equation (2), we get $14d = 28 \Rightarrow d = 2$

Substituting the value of d in equation (1), we get $a = 2$. $\therefore a = 2$ and $d = 2$

3. Find the sum of the first 22 terms of an AP whose first term is 4 and the common difference is $4/3$.

☞ **Solution:** Given that, $a = 4$ and $d = 4/3$.

$$\text{We have } S_n = \frac{n}{2} [2a + (n-1)d]$$

$$S_{22} = \left(\frac{22}{2} \right) \left[(2)(4) + (22-1) \left(\frac{4}{3} \right) \right]$$

$$= (11)(8 + 28) = 396$$

4. Find the three terms in AP whose sum is 36 and product is 960.

☞ **Solution:** Let the three terms of an A.P. be $(a-d)$, a and $(a+d)$. Sum of these terms is $3a$. $3a = 36 \Rightarrow a = 12$

Product of these three terms is

$$(a+d)a(a-d) = 960$$

$$\Rightarrow (12+d)(12-d) = 80 \Rightarrow 144 - d^2 = 80 \Rightarrow d = \pm 8$$

Taking $d = 8$, we get the terms as 4, 12 and 20.

Note: If d is taken as -8 , then the same numbers are obtained, but in decreasing order.

5. Find the difference between the 25th term and the 15th term of the progression $-13, -17, -21, \dots$

☞ **Solution:** Given progression $-13, -17, -21, \dots$ is in A.P.

$$d = -4$$

$$\text{The required difference} = |t_{25} - t_{15}| =$$

$$\therefore |(a + 24d) - (a + 14d)| = |10d| = |10(-4)| = 40$$

6. Find the 7th term of the GP whose first term is 6 and common ratio is $2/3$.

☞ **Solution:** Given that, $t_1 = 6$ and $r = 2/3$

$$\text{We have } t_n = a \cdot r^{n-1}$$

$$\Rightarrow t_7 = (6) \left(\frac{2}{3} \right)^6 = \frac{(6)(64)}{729} = \frac{128}{243}.$$

7. Find the geometric mean of first twenty five powers of twenty five.

☞ **Solution:** The GM of the first 25 powers of 25 = $[25^1 \times 25^2 \times 25^3 \dots 25^{25}]^{1/25}$

$$= [25^{1+2+\dots+25}]^{1/25} = \left[25^{\frac{25 \times 26}{2}} \right]^{\frac{1}{25}} = 25^{13} = 5^{26}$$

8. In a geometric progression, the sum of first n terms is 65535. If the last term is 49152 and the common ratio is 4, then find the value of n .

☞ **Solution:** Let the common ratio and the first term of the GP be r and a respectively.

$$\text{Given, } r = 4 \text{ and } ar^{n-1} = 49152 \Rightarrow ar^n = 49152r$$

$$\Rightarrow ar^n = 49152 \times 4 \quad \dots (1)$$

$$\text{Also, } \frac{a(r^n - 1)}{r - 1} = 65535 \Rightarrow \frac{a(r^n - 1)}{3} = 65535$$

$$\Rightarrow ar^n - a = 3 \times 65535 \Rightarrow 49152 \times 4 - 3 \times 65535$$

$$= a \Rightarrow a = 3. \text{ Substituting } a = 3 \text{ in } ar^{n-1}$$

$$= 49152. \text{ We get } n = 8.$$

9. Insert three harmonic means between $\frac{1}{12}$ and $\frac{1}{20}$.

☞ **Solution:** After inserting the harmonic means let the harmonic progression be

$$\frac{1}{a}, \frac{1}{a+d}, \frac{1}{a+2d}, \frac{1}{a+3d}, \frac{1}{a+4d}$$

$$\text{Given } \frac{1}{a} = \frac{1}{12} \text{ and } \frac{1}{a+4d} = \frac{1}{20} \Rightarrow a = 12 \text{ and } d = 2$$

\therefore The required harmonic means are

$$\frac{1}{14}, \frac{1}{16} \text{ and } \frac{1}{18}.$$

10. Find the 10th term of harmonic progression

$$\frac{1}{5}, \frac{4}{19}, \frac{2}{9}, \frac{4}{17}, \dots$$

👉 **Solution:** Given, HP is $\frac{1}{5}, \frac{4}{19}, \frac{2}{9}, \frac{4}{17}, \dots$

$$\Rightarrow 5, \frac{19}{4}, \frac{9}{2}, \dots \text{are in AP}$$

$$\Rightarrow d = t_2 - t_1 = \frac{19}{4} - 5 = -\frac{1}{4}$$

$$a = 5, d = -\frac{1}{4} \text{ and } t_n = a + (n-1)d \Rightarrow t_{10} = a + 9d$$

$$= 5 + 9 \times -\frac{1}{4} = \frac{11}{4} \therefore \text{In HP, } t_{10} = \frac{4}{11}$$

PRACTICE EXERCISE 13 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- Third term of the sequence whose n^{th} term is $2n + 5$, is _____.
 (1) 1 (2) 11
 (3) 2 (4) 12
- In a series, if $T_n = 3 - n$, then $S_5 =$ _____.
 (1) 15 (2) 5
 (3) 0 (4) -2
- If $t_n = 6n + 5$, then $t_{n+1} =$ _____.
 (1) $6n - 1$ (2) $6n + 11$
 (3) $6n + 6$ (4) $6n - 5$
- If $t_n = 3^{n-1}$, then $S_6 - S_5 =$ _____.
 (1) 243 (2) 81
 (3) 77 (4) 27
- Write the sum of the first three terms of the following sequence whose n^{th} term is $3n + 1$.
 (1) 20 (2) 10
 (3) 21 (4) 12
- Find the sum of the last three terms of the following sequence whose n^{th} term is 5^{n+1} .
 (1) $30(5)^n$ (2) $31(5)^n$
 (3) $30(5)^{n-1}$ (4) $31(5)^{n-1}$
- In a sequence, if $t_n = \frac{n^2 - 1}{n+1}$, then find the value of $S_6 - S_3$.
 (1) 3 (2) 6
 (3) 12 (4) 10
- The tenth term of the series 9, 8, 7, 6 is _____.
 (1) -1 (2) 1
 (3) 0 (4) -2
- $\sum_{x=1}^{100} x =$ _____.
 (1) 100 (2) 5050
 (3) 1000 (4) 50
- $1 + 3 + 5 + \dots + 99 =$ _____.
 (1) $(99)^2$ (2) $(49)^2$
 (3) $(50)^2$ (4) $(100)^2$
- If the k^{th} term of the arithmetic progression 25, 50, 75, 100, is 1000, then find the value of k .
 (1) 40 (2) 50
 (3) 35 (4) 30
- If the 5th term and the 14th term of an AP are 35 and 8 respectively, then find the 20th term of the AP.
 (1) 10 (2) 20
 (3) -12 (4) -10
- Find the least number of terms of an A.P., $64 + 49 + 34 + \dots$ to be added so that the sum is less than 36.
 (1) 12 (2) 9
 (3) 10 (4) 8
- If the sum of 16 terms of an arithmetic progression is 1624 and the first term is 500 times the common difference, then find the common difference.
 (1) $\frac{1}{5}$ (2) $\frac{2}{3}$
 (3) $\frac{3}{5}$ (4) $\frac{2}{5}$
- Find the sum of $\frac{0.3}{0.5} + \frac{0.33}{0.55} + \frac{0.333}{0.555} + \dots$ to 15 terms.
 (1) 10 (2) 9
 (3) 3 (4) 5
- Find the sum of all natural numbers and lying between 100 and 200 which leave a remainder of 2 when divided by 5 in each case.
 (1) 2990 (2) 2847
 (3) 2936 (4) None of these
- Find the sum of the series $1 + (1 + 2) + (1 + 2 + 3) + (1 + 2 + 3 + 4) + \dots + (1 + 2 + 3 + \dots + 20)$.
 (1) 1470 (2) 1540
 (3) 1610 (4) 1370
- Geometric mean of 5 and 20 is _____.
 (1) 10 (2) -20
 (3) 15 (4) 12.5
- The reciprocals of all the terms of a geometric progression form a _____ progression.
 (1) AP (2) HP
 (3) GP (4) AGP
- $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots =$ _____.
 (1) 1 (2) 2
 (3) $3\frac{1}{4}$ (4) $4\frac{3}{4}$

21. If the sum of n terms which are in GP is $a(r + 1)$, then the number of terms is _____. (where 'a' is the first term and 'r' is the common ratio)
- (1) 8 (2) 6
(3) 4 (4) 2
22. 6th term of $\frac{1}{4}, \frac{1}{2}, 1, \dots$
- (1) 8 (2) 6
(3) 4 (4) 2
23. The common ratio of $3(2)^3, 3(2)^4, 3(2)^5$ is
- (1) 1 (2) 2
(3) 3 (4) 4
24. Find the sum of 5 geometric means between $1/3$ and 243, by taking common ratio positive.
- (1) 121 (2) 126
(3) 81 (4) 111
25. The product of three numbers of a GP is $\frac{64}{27}$. If the sum of their products when taken in pairs is $\frac{148}{27}$, then find the sum of the three numbers.
- (1) $\frac{16}{9}$ (2) $\frac{37}{9}$
(3) $\frac{31}{9}$ (4) $\frac{26}{9}$
26. Evaluate $\sum 2^i$, where $i = 2, 3, 4, \dots, 10$.
- (1) 2044 (2) 2048
(3) 1024 (4) 1022
27. A ball is dropped from a height of 64 m and rebounds $3/4$ of the distance every time it touches the ground. Find the total distance it travels before it comes to rest.
- (1) 444 (2) 512
(3) 448 (4) 384
28. One side of an equilateral triangle is 36 cm. The mid points of its sides are joined to form another triangle. Again another triangle is formed by joining the mid points of the sides of this triangle and the process is continued indefinitely. Determine the sum of areas of all such triangles including the given triangle (in cm^2).
- (1) $432\sqrt{3}$ (2) $324\sqrt{3}$
(3) $648\sqrt{3}$ (4) $430\sqrt{3}$
29. If $|x| < 1$, then find the sum of the series $2 + 4x + 6x^2 + 8x^3 + \dots$
- (1) $\frac{2}{1-x}$ (2) $\frac{2}{1-x^2}$
(3) $\frac{2}{(1-x)^2}$ (4) $\frac{2}{1+x}$
30. If a, b, c and d are in harmonic progression, then $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ and $\frac{1}{d}$ are in _____ progression.
- (1) AP (2) GP
(3) HP (4) AGP
31. If the AM of two numbers is 9 and their HM is 4, then their GM is _____.
- (1) 6 (2) 36
(3) 16 (4) 6.5
32. $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots$ are in _____.
- (1) AP (2) GP
(3) HP (4) None of these
33. HM of 3 and 5 is _____
- (1) $15/4$ (2) $15/8$
(3) $3/4$ (4) $5/8$
34. Find the sum to 9 terms of the series $0 \times 3 + 0.33 + 0.333 + \dots$
- (1) $\frac{8 \cdot 10^{10} + 1}{27 \cdot 10^9}$ (2) $\frac{9 \cdot 10^{10} + 1}{27 \cdot 10^9}$
(3) $\frac{9 \cdot 10^9 + 1}{27 \cdot 10^8}$ (4) $\frac{8 \cdot 10^9 + 1}{27 \cdot 10^8}$
35. Find the sum of all three-digit numbers which leave a remainder 2, when divided by 6.
- (1) 82656 (2) 82658
(3) 82650 (4) 82654

PRACTICE EXERCISE 13 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. In a sequence, if S_n is the sum of the first n terms and S_{n-1} is the sum of the first $(n - 1)$ terms, then the n^{th} term is _____.

- (1) S_{n-2} (2) $S_n - S_{n-1}$
(3) $S_{n+1} - S_n$ (4) $S_{n+1} - S_{n-1}$
2. If $T_n = 3n + 8$, then $T_{n-1} =$ _____.
- (1) $3n + 7$ (2) $3n + 6$
(3) $3n - 5$ (4) $3n + 5$

3. If $t_n = 5 - 2n$, then $t_{n-1} =$ ____.
- (1) $2n - 1$ (2) $7 + 2n$
 (3) $4 - 2n$ (4) $7 - 2n$
4. Find the sum of first three terms of the following sequence whose n^{th} term is $8 - 5n$.
- (1) -9 (2) -6
 (3) 6 (4) 12
5. Find the sum of the first three terms of the following sequence whose n^{th} term is $5n^2 - 2$.
- (1) $15n^2 - 30n + 19$ (2) $15n^2 - 19$
 (3) $15n^2 - 25n + 18$ (4) $15n^2 - 20n + 18$
6. Find the general term of a sequence, whose sum of n terms is given by $4n^2 + 3n$.
- (1) $8n + 1$ (2) $4n - 2$
 (3) $8n - 1$ (4) $4n - 1$
7. The sum of the first 20 terms of the sequence 1, 4, 9, ... is ____.
- (1) 2870 (2) 2890
 (3) 2970 (4) 2780
8. The sum of 100 terms of the progression 5, 5, 5, is ____.
- (1) 500 (2) 5000
 (3) 50 (4) 5
9. $\Sigma n^3 =$ ____.
- (1) $(\Sigma n)^3$ (2) $(\Sigma n)^2$
 (3) $(\Sigma n)^3 + (\Sigma n)^2$ (4) $\Sigma(n + n^2)$
10. Find the 15th term of the arithmetic progression 10, 4, -2, ...
- (1) 75 (2) -75
 (3) -74 (4) -90
11. How many terms are needed in the series -15, -12, -9, so that their sum is 18?
- (1) 15 (2) 10
 (3) 12 (4) 18
12. Which of the following does not belong to the series 8, 11, 14, 17, 20,?
- (1) 120 (2) 131
 (3) 144 (4) 150
13. Find the number of terms in an arithmetic progression for which the first term is 4, last term is 22 and the common difference is $1/4$.
- (1) 70 (2) 71
 (3) 72 (4) 73
14. If two AP's have the same first term and the difference between their common difference is 2, then the difference between the sum of their first 10 terms is ____.
- (1) 20 (2) 18
 (3) 90 (4) 100
15. If 8 times the 8th term of an arithmetic progression is equal to 12 times the 12th term, then the 20th term is
- (1) 12 times to 8th term
 (2) 8 times to 12th term
 (3) 0
 (4) Cannot be determined
16. An arithmetic progression starts with a positive fraction and every alternate term is an integer. If the sum of the first 11 terms is 33, then find the fourth term.
- (1) 2 (2) 3
 (3) 5 (4) 6
17. Find the sum of 100 terms of the series $1(3) + 3(5) + 5(7) + \dots$
- (1) 1353300 (2) 1353400
 (3) 1353200 (4) 1353100
18. If the seventh term of an AP is 25 and the common difference is 4, then find the 15th term of AP.
- (1) 55 (2) 50
 (3) 57 (4) 52
19. If a , b and c are in geometric progression, then a^2 , b^2 and c^2 are in ____ progression.
- (1) AP (2) GP
 (3) HP (4) AGP
20. The n^{th} term of the sequence $\frac{1}{100}, \frac{1}{10000}, \frac{1}{1000000}, \dots$ is ____.
- (1) $(100)^n$ (2) 10^{-2n}
 (3) 10^{-2n} (4) 10^{-n}
21. Fifth term of $\frac{1}{16}, \frac{1}{8}, \frac{1}{4}, \dots$ is ____.
- (1) $1/2$ (2) 1
 (3) 0 (4) 2
22. The product of t_5 and t_6 of the progression $1/4, 1/2, 1, \dots$ is
- (1) t_8 (2) t_{11}
 (3) t_{10} (4) t_7
23. GM of 4 and 64
- (1) 32 (2) 8
 (3) 16 (4) 24

24. $2 + 1 + \frac{1}{2} + \frac{1}{4} + \dots \infty$
- (1) 1 (2) 2
(3) 3 (4) 4
25. If in a G.P., 5th term and the 12th term are 9 and $\frac{1}{243}$ respectively, find the 9th term of G.P.
- (1) $\frac{1}{7}$ (2) $\frac{1}{8}$
(3) $\frac{1}{9}$ (4) $\frac{1}{81}$
26. Find the geometric mean of the first 36 powers of 36.
- (1) $(36)^{36}$ (2) $(36)^{37}$
(3) $(6)^{37}$ (4) $(6)^{36}$
27. Find the sum to 90 terms of the series $5 + 55 + 555 + \dots$
- (1) $\frac{50}{81}[10^{90} - 82]$ (2) $\frac{50}{81}[10^{90} - 83]$
(3) $\frac{50}{81}[10^{90} - 80]$ (4) $\frac{50}{81}[10^{90} - 90]$
28. $\sqrt{x}, \sqrt{2x}, 2\sqrt{x}, 2\sqrt{2x}, \dots$ are in geometric progression. If the sum of first 10 terms is $31(\sqrt{6} + \sqrt{3})$, then find the 10th term.
- (1) $8\sqrt{3}$ (2) $8\sqrt{6}$
(3) $16\sqrt{6}$ (4) $16\sqrt{3}$
29. Find the 10th term of a geometric progression in which the product of the first three terms is 1728 and the sum of next three terms is 756. (where common ratio is an integer)
- (1) $2^2 \cdot 3^9$ (2) $2^3 \cdot 3^{10}$
(3) $2^5 \cdot 3^{10}$ (4) $2^3 \cdot 3^9$
30. The harmonic mean of 20 and 30 is ____.
- (1) 25 (2) 28
(3) 26 (4) 24
31. 100, 100, 100, are in ____.
- (1) AP (2) GP
(3) HP (4) All of these
32. 7th term of $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \dots$ is ____.
- (1) $1/10$ (2) $1/12$
(3) $1/14$ (4) $1/16$
33. The relation among AM, GM and HM is
- (1) $AM \times GM = HM$ (2) $HM = \sqrt{AM \times GM}$
(3) $GM^2 = AM \times HM$ (4) $AM^2 = GM \times HM$
34. If $\frac{1}{q+r}, \frac{1}{r+p}$ and $\frac{1}{p+q}$ are in AP, then show that p^2, q^2 and r^2 are in ____.
- (1) AP (2) GP
(3) HP (4) AGP
35. A person opens an account with ₹50 and starts depositing every day double the amount he has deposited on the previous day. Then find the amount he has deposited on the 10th day from the beginning.
- (1) ₹25000 (2) ₹25600
(3) ₹28500 (4) ₹26500

ANSWER KEYS

PRACTICE EXERCISE 13 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 3 | 3. 2 | 4. 1 | 5. 3 | 6. 4 | 7. 3 | 8. 3 | 9. 2 | 10. 3 |
| 11. 1 | 12. 4 | 13. 3 | 14. 1 | 15. 2 | 16. 1 | 17. 2 | 18. 1 | 19. 3 | 20. 1 |
| 21. 4 | 22. 1 | 23. 2 | 24. 1 | 25. 2 | 26. 1 | 27. 3 | 28. 1 | 29. 3 | 30. 1 |
| 31. 1 | 32. 3 | 33. 1 | 34. 1 | 35. 3 | | | | | |

PRACTICE EXERCISE 13 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 4 | 4. 2 | 5. 1 | 6. 3 | 7. 1 | 8. 1 | 9. 2 | 10. 3 |
| 11. 3 | 12. 1 | 13. 4 | 14. 3 | 15. 3 | 16. 1 | 17. 1 | 18. 3 | 19. 2 | 20. 3 |
| 21. 2 | 22. 4 | 23. 3 | 24. 4 | 25. 3 | 26. 3 | 27. 1 | 28. 3 | 29. 1 | 30. 4 |
| 31. 4 | 32. 3 | 33. 3 | 34. 1 | 35. 2 | | | | | |

Statements

SYNOPSIS

- **Statement:** A sentence which can be judged either true or false but not both is called a **statement**. Statements are denoted by lower case letters like p, q, r etc.
- **Truth value:** The truthness or falsity of a statement is called its truth value. Truthness of a statement is denoted by T, while its falsity is denoted by F.
- **Negation of a statement:** The denial of a statement is called its negation. Negation of a statement p is denoted by $\sim p$ and read as not p or negation p .

Truth table:

p	$\sim p$
T	F
F	T

- **Compound statement:** A statement obtained by combining two or more simple statements using connectives is called a compound statement.
- **Conjunction:**

Truth table:

p	q	$p \wedge q$
T	T	T
T	F	F

p	q	$p \wedge q$
F	T	F
F	F	F

We observe that $p \wedge q$ is true only when both p and q are true.

- **Disjunction:**

Truth table:

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

We observe that, $p \vee q$ is false only when both p and q are false.

- **Implication or Conditional:**

Truth table:

p	q	$p \Rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

We observe that, a true statement cannot imply a false statement.

○ **Bi-conditional or Bi-implication:**

Truth table:

p	q	$p \Leftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T

We observe that, $p \Leftrightarrow q$ is true if both p and q have the same truth values.

○ **Converse, inverse and contrapositive of a conditional:**

Let $p \Rightarrow q$ or if p then q be a conditional,

- (i) If q then p i.e., $q \Rightarrow p$, is called the converse of $p \Rightarrow q$.
- (ii) If not p then not q i.e., $\sim p \Rightarrow \sim q$, is called the inverse of $p \Rightarrow q$.
- (iii) If not q then not p i.e., $\sim q \Rightarrow \sim p$ is called the contrapositive of $p \Rightarrow q$.

○ **Truth table:**

p	q	$\sim p$	$\sim q$	Conditional $p \Rightarrow q$	Converse $q \Rightarrow p$	Inverse $\sim p \Rightarrow \sim q$	Contrapositive $\sim q \Rightarrow \sim p$
T	T	F	F	T	T	T	T
T	F	F	T	F	T	T	F
F	T	T	F	T	F	F	T
F	F	T	T	T	T	T	T

○ **Tautology:** A compound statement which always takes **True** as its truth value is called a tautology.

Examples:

p	$\sim p$	$p \vee \sim p$
T	F	T
F	T	T

We observe that $p \vee \sim p$ takes T as its truth value always. So, $p \vee \sim p$ is a tautology.

○ **Contradiction:** A compound statement which always takes **False** as its truth value is called a contradiction.

Examples:

p	$\sim p$	$p \wedge \sim p$
T	F	F
F	T	F

We observe that $p \wedge \sim p$ takes F as its truth value always. So $p \wedge \sim p$ is a contradiction.

○ **Contingency:** A compound statement which is neither a tautology nor a contradiction is called a contingency.

Truth table:

p	q	$\sim p$	$p \vee q$	$p \vee q \Rightarrow \sim p$
T	T	F	T	F
T	F	F	T	F

p	q	$\sim p$	$p \vee q$	$p \vee q \Rightarrow \sim p$
F	T	T	T	T
F	F	T	F	T

○ **Logically equivalent statements:** Two statements r and s are said to be logically equivalent, if the last columns of their truth tables are identical.

Laws of Algebra of Statements

1. Commutative Laws:

- (a) $p \vee q \equiv q \vee p$
- (b) $p \wedge q \equiv q \wedge p$

2. Associative laws:

- (a) $(p \vee q) \vee r \equiv p \vee (q \vee r)$
- (b) $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$

3. Distributive Laws:

- (a) $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
- (b) $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

4. Idempotent Laws:

- (a) $p \vee p \equiv p$
- (b) $p \wedge p \equiv p$

5. De Morgan's laws:

(a) $\sim(p \vee q) \equiv (\sim p) \wedge (\sim q)$

(b) $\sim(p \wedge q) \equiv (\sim p) \vee (\sim q)$

6. Identity Laws:

(a) $p \vee f \equiv p, p \vee t \equiv t.$

(b) $p \wedge f \equiv f, p \wedge t \equiv p.$

7. Complement Laws:

(a) $p \vee (\sim p) \equiv t$

(b) $p \wedge (\sim p) \equiv f$

(c) $\sim(\sim p) \equiv p$

(d) $\sim t \equiv f$

(e) $\sim f \equiv t$

List of Equivalences based on Implications

(i) $p \Rightarrow q \equiv \sim p \vee q$

(ii) $\sim(p \Rightarrow q) \equiv p \wedge \sim q$

(iii) $p \Rightarrow q \equiv \sim q \Rightarrow \sim p$

(i.e., a conditional and its contrapositive are logically equivalent)

(iv) $q \Rightarrow p \equiv \sim q \Rightarrow \sim p$

(i.e., converse and inverse of a conditional are logically equivalent)

(v) $p \Leftrightarrow q \equiv (p \Rightarrow q) \wedge (q \Rightarrow p)$

(vi) $\sim(p \Leftrightarrow q) \equiv (\sim p) \Leftrightarrow q \text{ or } p \Leftrightarrow (\sim q)$

- **Open sentence:** A sentence involving one or more variables is called an open sentence, if it becomes TRUE or FALSE when the variables are replaced by some specific values from the given set. The set from which the values of a variable can be considered is called the replacement set or domain of the variable.
- **Quantifiers:** A quantifier is a word or phrase which quantifies a variable in the given open sentence. There are two types of quantifiers.

Universal quantifier

The quantifiers like for all, for every, for each are called universal quantifiers. A universal quantifier is denoted by ' \forall '.

Existential quantifier

The quantifiers like for some, not all, there is/exists at least one are called existential quantifiers. An existential quantifier is denoted by ' \exists '.

Negation of Statements Involving Quantifiers1. p : All odd numbers are prime. $\sim p$: Not all odd numbers are prime

(or)

Some odd numbers are not prime.

(or)

There is an odd number which is not prime.

Application to Switching Networks

Now we consider the statements p and p^1 as switches with the property that if one is on, then the other is off and vice-versa.

Further, a switch allows only two possibilities. They are

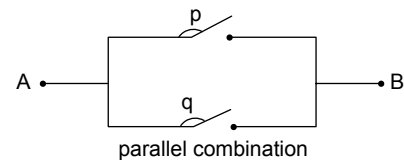
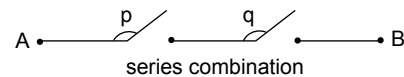
(i) it is either open (F) in which case there is no flow of current.

(or)

(ii) it is closed (T) in which case there is a flow of current.

Hence, every switch has two truth values T or F only.

Let p and q denote two switches. We can connect p and q by using a wire in a series or parallel combination as shown below.

**Note:**

$p \wedge q$ denote the series combination and $p \vee q$ denote the parallel combination.

Switching Network

A switching network is a repeated arrangement of wires and switches in series and parallel combinations.

So, such a network can be described by using the connectives \wedge and \vee .

Solved Examples

1. Write the conjunction and implication of the following statements:

(a) $x + 3 = 0$; $x = -3$

(b) He is smart; He is intelligent.

☞ **Solution:**

(a) Conjunction: $x + 3 = 0$ and $x = -3$

Implication: If $x + 3 = 0$, then $x = -3$

(b) Conjunction: He is smart and he is intelligent.

Implication: If he is smart, then he is intelligent.

2. Write the truth table of $p \Rightarrow (p \wedge q)$.

☞ **Solution:** Truth table of $p \Rightarrow p \wedge q$:

p	q	$p \wedge q$	$p \Rightarrow p \wedge q$
T	T	T	T
T	F	F	F
F	T	F	T
F	F	F	T

3. Write the converse, inverse and contrapositive of the conditional, "If she is rich, then she is happy".

☞ **Solution:** Conditional: If she is rich, then she is happy.

Converse: If she is happy, then she is rich.

Inverse: If she is not rich, then she is not happy.

Contrapositive: If she is not happy, then she is not rich.

4. Show that $p \Rightarrow p \vee q$ is a tautology.

☞ **Solution:** Truth table of $p \Rightarrow p \vee q$:

p	q	$p \vee q$	$p \Rightarrow p \vee q$
T	T	T	T
T	F	T	T
F	T	T	T
F	F	F	T

Since $p \Rightarrow p \vee q$ is always true, $p \Rightarrow p \vee q$ is a tautology.

5. Show that $(p \wedge \sim p) \wedge (p \vee q)$ is a contradiction.

☞ **Solution:** Truth table of $(p \wedge \sim p) \wedge (p \vee q)$:

p	q	$\sim p$	$p \vee q$	$p \wedge \sim p$	$(p \wedge \sim p) \wedge (p \vee q)$
T	T	F	T	F	F
T	F	F	T	F	F
F	T	T	T	F	F
F	F	T	F	F	F

we observe that $(p \wedge \sim p) \wedge (p \vee q)$ is always false.

Hence, $(p \wedge \sim p) \wedge (p \vee q)$ is a contradiction.

6. Prove that $(\sim p \wedge q) \wedge q$ is neither a tautology nor a contradiction.

☞ **Solution:** Truth table of $(\sim p \wedge q) \wedge q$:

p	q	$\sim p$	$\sim p \wedge q$	$(\sim p \wedge q) \wedge q$
T	T	F	F	F
T	F	F	F	F
F	T	T	T	T
F	F	T	F	F

$\therefore (\sim p \wedge q) \wedge q$ is neither true always nor false always.

Hence, $(\sim p \wedge q) \wedge q$ is neither a tautology nor a contradiction.

7. Write the suitable quantifier for the following sentences

(a) $x + 1 > x$ for all real values of x .

(b) there exists a real number x such that $x + 2 = 3$.

(c) there is no real number x such that $x^2 + 2x + 2 = 0$.

☞ **Solution:**

(a) Universal quantifier (\forall)

(b) Existential quantifier (\exists)

(c) Universal quantifier (\forall)

8. Show that $\sim(p \wedge q) \equiv \sim p \vee \sim q$.

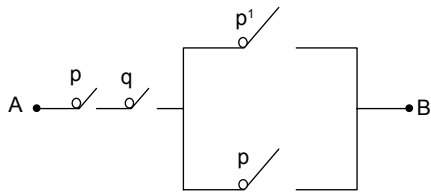
☞ **Solution:** Truth table:

p	q	$\sim p$	$\sim q$	$p \wedge q$	$\sim(p \wedge q)$	$\sim p \vee \sim q$
T	T	F	F	T	F	F
T	F	F	T	F	T	T

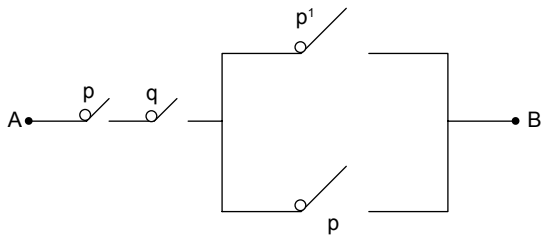
p	q	$\sim p$	$\sim q$	$p \wedge q$	$\sim(p \wedge q)$	$\sim p \vee \sim q$
F	T	T	F	F	T	T
F	F	T	T	F	T	T

The truth values of $\sim(p \wedge q)$ and $\sim p \vee \sim q$ are same
Hence, $\sim(p \wedge q) \equiv \sim p \vee \sim q$

9. Discuss when does the current flow from A to B in the network given.



Solution: Given network is



The network can be described by the compound statement $(p \wedge q) \wedge (p' \vee p)$.

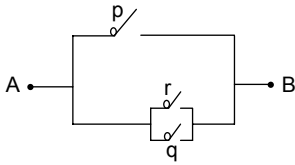
Truth table of $(p \wedge q) \wedge (p' \vee p)$ is:

p	q	p'	$p \wedge q$	$p' \vee p$	$(p \wedge q) \wedge (p' \vee p)$
T	T	F	T	T	T
T	F	F	F	T	F
F	T	T	F	T	F
F	F	T	F	T	F

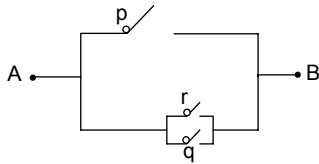
So, the current flows from A to B if.

- (i) p is closed, q is closed.

10. Discuss when does the current flow from A to B in the given network.



Solution: Given network is:



The network can be described by the statement of $p \vee (q \vee r)$

p	q	r	$q \vee r$	$p \vee (q \vee r)$
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
F	T	T	T	T
T	F	F	F	T
F	T	F	T	T
F	F	T	T	T
F	F	F	F	F

So, the current flows from A to B in the following cases.

- (i) p is closed, q is closed, r is closed
- (ii) p is closed, q is closed, r is open
- (iii) p is closed, q is open, r is closed
- (iv) p is open, q is closed, r is closed
- (v) p is closed, q is open, r is open
- (vi) p is open, q is closed, r is open
- (vii) p is open, q is open, r is closed.

PRACTICE EXERCISE 14 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

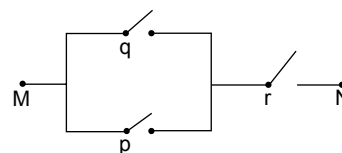
1. Which of the following sentences is a statement?
 - (1) Ramu is a clever boy.
 - (2) What are you doing?
 - (3) Oh! It is amazing.
 - (4) Two is an odd number.
2. Find the truth value of "Are you attending the meeting tomorrow?".
 - (1) T
 - (2) F
 - (3) Neither T nor F
 - (4) Both (1) and (2)
3. The statement $p \Rightarrow p \vee q$ is
 - (1) a tautology.
 - (2) a contradiction.
 - (3) both tautology and contradiction.
 - (4) neither a tautology nor a contradiction.
4. For which of the following cases does the statement $p \wedge \sim q$ take the truth value as true?
 - (1) p is true, q is true.
 - (2) p is false, q is true.
 - (3) p is false, q is false.
 - (4) p is true, q is false.
5. The symbolic form of the statement, "If p, then neither q nor r" is
 - (1) $p \Rightarrow q \wedge r$.
 - (2) $p \Rightarrow \sim q \wedge \sim r$.
 - (3) $p \Rightarrow \sim q \vee \sim r$.
 - (4) $p \Rightarrow \sim q \wedge r$.
6. Find the quantifier which best describes the variable of the open sentence $x^2 + 2 \geq 0$.
 - (1) Universal.
 - (2) Existential.
 - (3) Neither (1) nor (2).
 - (4) Does not exist.
7. The contrapositive of the statement $p \Rightarrow \sim q$ is
 - (1) $\sim p \Rightarrow q$.
 - (2) $p \Rightarrow q$.
 - (3) $\sim q \Rightarrow \sim p$.
 - (4) $q \Rightarrow \sim p$.
8. Which of the following laws does the connective \wedge satisfy?
 - (1) Commutative law
 - (2) Idempotent law
 - (3) Associative law
 - (4) All the above
9. Which of the following is a tautology?
 - (1) $p \wedge q$
 - (2) $p \vee q$
 - (3) $p \vee \sim p$
 - (4) $p \wedge \sim p$
10. Find the inverse of the conditional, "If I am tired, then I will take rest".
 - (1) If I am tired, then I will not take rest.
 - (2) If I am not tired, then I will take rest.
 - (3) If I am not tired, then I will not take rest.
 - (4) None of these
11. Which of the following compound statement represents a series network?
 - (1) $p \vee q$
 - (2) $p \Rightarrow q$
 - (3) $p \wedge q$
 - (4) $p \Leftrightarrow q$
12. Find the truth value of the compound statement, 4 is the first composite number and $2 + 5 = 7$.
 - (1) T
 - (2) F
 - (3) Neither T nor F
 - (4) Cannot be determined
13. Find the truth value of the compound statement, 'If 2 is a prime number, then hockey is the national game of India'.
 - (1) T
 - (2) F
 - (3) Neither T nor F
 - (4) Cannot be determined
14. What is the truth value of the statement "Two is an odd number iff 2 is a root of $x^2 + 2 = 0$ "?
 - (1) T
 - (2) F
 - (3) Neither T nor F
 - (4) Cannot be determined
15. The negation of the statement, "I go to school every-day", is
 - (1) I never go to school.
 - (2) Some days, I do not go to school.
 - (3) Not all the days I do not go to school.
 - (4) All days I go to school.
16. Which of the following pairs are logically equivalent?
 - (1) Conditional, Contrapositive
 - (2) Conditional, Inverse
 - (3) Contrapositive, Converse
 - (4) Inverse, Contrapositive
17. Find the converse of the statement, "If ABCD is square, then it is a rectangle".
 - (1) If ABCD is a square, then it is not a rectangle.
 - (2) If ABCD is not a square, then it is a rectangle.
 - (3) If ABCD is a rectangle, then it is square.
 - (4) If ABCD is not a square, then it is not a rectangle.

18. The property $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$ is called
 (1) associative law (2) commutative law
 (3) distributive law (4) idempotent law
19. The counter example of the statement, "All odd numbers are primes", is
 (1) 7 (2) 5
 (3) 9 (4) All the above
20. Which of the following is equivalent to $p \Leftrightarrow q$?
 (1) $p \Rightarrow q$ (2) $q \Rightarrow p$
 (3) $(p \Rightarrow q) \wedge (q \Rightarrow p)$ (4) None of these
21. If p : The number of factors of 20 is 5 and q : 2 is an even prime number, then the truth values of inverse and contrapositive of $p \Rightarrow q$ respectively are
 (1) T, T (2) F, F
 (3) T, F (4) F, T
22. If p : 3 is an odd number and q : 15 is a prime number, then $[\sim(p \Leftrightarrow q)]$ is equivalent to _____.
 (a) $p \Leftrightarrow (\sim q)$ (b) $(\sim p) \Leftrightarrow q$
 (c) $\sim(p \wedge q)$
 (1) only (a) (2) only (c)
 (3) Both (a) and (b) (4) (a), (b) and (c)
23. Which of the following is a tautology?
 (1) $p \Rightarrow p \wedge q$ (2) $p \Rightarrow p \vee q$
 (3) $(p \vee q) \Rightarrow (p \wedge q)$ (4) None of these
24. $p \Rightarrow [p \vee (\sim q)]$ is a
 (1) contradiction (2) tautology
 (3) contingency (4) None of these
25. Which of the following is contingency?
 (1) $p \vee \sim p$ (2) $p \wedge q \Rightarrow p \vee q$
 (3) $p \wedge (\sim q)$ (4) None of these
26. The compound statement, "If you want to top the school, then you do not study hard" is equivalent to
 (1) "If you want to top the school, then you need to study hard".
 (2) "If you will not top in the school, then you study hard".
 (3) "If you study hard, then you will not top the school".
 (4) "If you do not study hard, then you will top in the school".
27. Write the negation of the statement "If the switch is on, then the fan rotates".

- (1) "If the switch is not on, then the fan does not rotate".
 (2) "If the fan does not rotate, then the switch is not on".
 (3) "The switch is not on or the fan rotates".
 (4) "The switch is on and the fan does not rotate".

28. If "All odd numbers are primes and the sum of three angles in a triangle is 190° ", then "All odd numbers are primes or the sum of the angles in a triangle is 190° " is a
 (1) tautology (2) contradiction
 (3) contingency (4) not a statement

29.



In the above network, current flows from M to N, when

- (1) q closed, r opened and p closed.
 (2) q opened, p opened and r closed.
 (3) q opened, p closed and r closed.
 (4) q closed, p closed and r opened.

30.



In the above network, current flows from N to T when

- (1) p closed, q closed, r opened and s opened.
 (2) p closed, q opened, s closed and r opened.
 (3) q closed, p opened, r opened and s closed.
 (4) p opened, q opened, r closed and s closed.

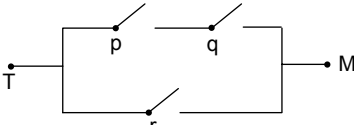
31. "No square of a real number is less than zero" is equivalent to
 (1) for every real number a , a^2 is non negative.
 (2) $\forall a \in \mathbb{R}, a^2 \geq 0$.
 (3) either (1) or (2).
 (4) None of these
32. Which of the following is/are counter example(s) of the statement $x^2 - 7x + 10 > 0$, for all real x ?
 (a) 2 (b) 3
 (c) 4 (d) 5
 (1) Only (a) and (d).
 (2) Only (b) and (c).

- (3) All (a), (b), (c) and (d).
 (4) None of these
33. "If a polygon is a triangle, then a polyhedron is a pyramid" is a _____
 (1) tautology
 (2) contradiction
 (3) contingency
 (4) None of these
34. If a compound statement r is contradiction, then find the truth value of $(p \Rightarrow q) \wedge (r) \wedge [p \Rightarrow (\sim r)]$.
 (1) T (2) F
 (3) T or F (4) None of these
35. When does the truth value of the statement $(p \vee r) \Leftrightarrow (q \vee r)$ become true?
 (1) p is true, q is true. (2) p is false, q is false.
 (3) p is true, r is true. (4) Both (1) and (3)

PRACTICE EXERCISE 14 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- Which of the following sentences is a statement?
 (1) What a cracking shot?
 (2) Please open the door.
 (3) Four is first prime number.
 (4) Thank you.
- The truth value of the statement, "We celebrate our Independence day on 15 August", is
 (1) T
 (2) F
 (3) neither T nor F
 (4) Cannot be determined
- The statement $p \vee q$ is
 (1) a tautology.
 (2) a contradiction.
 (3) neither a tautology nor a contradiction.
 (4) Cannot say.
- When does the inverse of the statement $\sim p \Rightarrow q$ results in T?
 (1) $p = T, q = T$ (2) $p = T, q = F$
 (3) $p = F, q = F$ (4) Both (2) and (3)
- Write the compound statement, "If p , then q and if q , then p " in symbolic form.
 (1) $(p \wedge q) \wedge (q \wedge p)$ (2) $(p \Rightarrow q) \vee (q \Rightarrow p)$
 (3) $(q \Rightarrow p) \wedge (p \Rightarrow q)$ (4) $(p \wedge q) \vee (q \wedge p)$
- Find the quantifier which best describes the variable of the open sentence $x + 3 = 5$.
 (1) Universal (2) Existential
 (3) Neither (1) nor (2) (4) Cannot be determined
- The converse of converse of the statement $p \Rightarrow \sim q$ is _____.
 (1) $\sim q \Rightarrow p$ (2) $\sim p \Rightarrow q$
 (3) $p \Rightarrow \sim q$ (4) $\sim q \Rightarrow \sim p$
- Which of the following connectives satisfy commutative law?
 (1) \wedge (2) \vee
 (3) \Leftrightarrow (4) All the above
- Which of the following is a contradiction?
 (1) $p \vee q$ (2) $p \wedge q$
 (3) $p \vee \sim p$ (4) $p \wedge \sim p$
- What is the converse of the statement $p \Rightarrow p \vee q$?
 (1) $p \vee q \Rightarrow p$ (2) $\sim p \Rightarrow p \wedge \sim q$
 (3) $\sim p \wedge \sim q \Rightarrow \sim p$ (4) $\sim p \Rightarrow p \vee q$
- Which of the following connectives can be used for describing a switching network?
 (1) \vee (2) \wedge
 (3) Both (1) and (2) (4) None of these
- What is the truth value of the statement, $2 \times 3 = 6$ or $5 + 8 = 10$?
 (1) T (2) F
 (3) Neither T nor F (4) Cannot be determined
- Find the truth value of the statement, "The sum of any two odd numbers is an odd number".
 (1) T (2) F
 (3) Neither T nor F (4) Cannot be determined
- In which of the following cases, $p \Leftrightarrow q$ is true?
 (1) p is true, q is true. (2) p is false, q is true.
 (3) p is true, q is false. (4) None of these

15. Find the negation of the statement, "Some odd numbers are not prime".
 (1) Some odd numbers are primes.
 (2) There is an odd number which is not a prime.
 (3) All odd numbers are primes.
 (4) Not all odd numbers are primes.
16. Which of the following pairs are logically equivalent?
 (1) Converse, Contrapositive
 (2) Conditional, Converse
 (3) Converse, Inverse
 (4) Conditional, Inverse
17. Find the inverse of the statement, "If ΔABC is equilateral, then it is isosceles".
 (1) If ΔABC is isosceles, then it is equilateral.
 (2) If ΔABC is not equilateral, then it is isosceles.
 (3) If ΔABC is not equilateral, then it is not isosceles.
 (4) If ΔABC is not isosceles, then it is not equilateral.
18. The property $\sim(p \wedge q) \equiv \sim p \vee \sim q$ is called _____.
 (1) associative law (2) De Morgan's law
 (3) commutative law (4) idempotent law
19. Find the counter example of the statement "Every natural number is either prime or composite".
 (1) 5 (2) 1
 (3) 6 (4) None of these
20. $p \Rightarrow q$ is logically equivalent to _____.
 (1) $p \vee \sim q$ (2) $\sim p \wedge q$
 (3) $p \wedge q$ (4) $\sim p \vee q$
21. If p: In a triangle, the centroid divides each median in the ratio 1: 2 from the vertex and q: In an equilateral triangle, each median is perpendicular bisector of one of its sides. The truth values of inverse and converse of $p \Rightarrow q$ are respectively
 (1) T, T (2) F, F
 (3) T, F (4) F, T
22. If p: 25 is a factor of 625 and q: 169 is a perfect square then $\sim(p \Rightarrow q)$ is equivalent to
 (1) $p \wedge q$ (2) $(\sim p) \wedge q$
 (3) $p \wedge (\sim q)$ (4) Both (2) and (3)
23. $(p \wedge q) \wedge (\sim q)$ is a
 (1) contradiction (2) tautology
 (3) contingency (4) None of these
24. Which of the following statements is a contradiction?
 (1) $p \vee q \Rightarrow p$ (2) $\sim(p \wedge q) \Rightarrow p$
 (3) $\sim(p \wedge q \Rightarrow p)$ (4) $p \wedge q \Rightarrow p$
25. The compound statement, "If you won the race, then you did not run faster than others" is equivalent to
 (1) "If you won the race, then you ran faster than others".
 (2) "If you ran faster than others, then you won the race".
 (3) "If you did not win the race, then you did not run faster than others".
 (4) "If you ran faster than others, then you did not win the race".
26. "If natural numbers are whole numbers, then rational numbers are integers" or "If rational numbers are integers, then natural numbers are whole numbers" is
 (1) a tautology (2) a contradiction
 (3) a contingency (4) not a statement
- 27.
- 
- In the above network, current flows from T to M, when
 (1) p closed, q closed and r opened.
 (2) p closed, q opened and r closed.
 (3) p opened, q closed and r closed.
 (4) All the above
28. Which of the following is negation of the statement "All birds can fly".
 (1) "Some birds cannot fly".
 (2) "All the birds cannot fly".
 (3) "There is at least one bird which can fly".
 (4) All the above
29. The counter example of the statement, "The roots of $x^2 - 6x - 112 = 0$ are natural numbers"?
 (1) -8 (2) 14
 (3) -16 (4) -7
30. "If x is a good actor, then y is bad actress" is
 (1) a tautology (2) a contradiction
 (3) a contingency (4) None of these

31. If p : $5x + 6 = 8$ is an open sentence and q : 3, 4 are the roots of the equation $x^2 - 7x + 12 = 0$, then which of following is equivalent to $\sim [\sim p \vee q]$?
- (1) "The negation of "If $5x + 6 = 8$ is an open sentence, then 3, 4 are the roots of the equation $x^2 - 7x + 12 = 0$ ".
 - (2) $5x + 6 = 8$ is an open sentence or 3, 4 are not roots of the equation $x^2 - 7x + 12 = 0$
 - (3) $5x + 6 = 8$ is not an open sentence and 3, 4 are the roots of the equation $x^2 - 7x + 12 = 0$
 - (4) None of these
32. If p : Every equilateral triangle is isosceles and q : Every square is a rectangle, then which of the following is equivalent to $\sim (p \Rightarrow q)$?
- (1) The negation of "Every equilateral triangle is not isosceles or every square is rectangle".
 - (2) "Every equilateral triangle is not isosceles, then every square is not a rectangle".
 - (3) "Every equilateral triangle is isosceles, then every square is a rectangle".
 - (4) None of these
33. Find the truth value of negation of compound statement $\sim [(\sim p \vee q) \wedge (\sim p \vee q)]$, when q is false.
- (1) only T
 - (2) only F
 - (3) Either T or F
 - (4) None of these
34. $\sim [p \vee (p \Rightarrow q)] \equiv$
- (1) p
 - (2) q
 - (3) T
 - (4) F
35. $\sim (\sim p \Leftrightarrow \sim q) \vee \sim (p \Leftrightarrow q) \equiv$
- (a) $\sim (p \Leftrightarrow q)$
 - (b) $\sim [\sim p \Leftrightarrow \sim q]$
 - (c) $p \Rightarrow \sim q$
 - (1) only (a)
 - (2) only (b)
 - (3) Both (a) and (b)
 - (4) only (c)

ANSWER KEYS

PRACTICE EXERCISE 14 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 1 | 4. 4 | 5. 2 | 6. 1 | 7. 4 | 8. 4 | 9. 3 | 10. 3 |
| 11. 3 | 12. 1 | 13. 1 | 14. 1 | 15. 2 | 16. 1 | 17. 3 | 18. 3 | 19. 3 | 20. 3 |
| 21. 4 | 22. 4 | 23. 2 | 24. 2 | 25. 3 | 26. 3 | 27. 4 | 28. 1 | 29. 3 | 30. 3 |
| 31. 3 | 32. 3 | 33. 4 | 34. 2 | 35. 4 | | | | | |

PRACTICE EXERCISE 14 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 3 | 4. 4 | 5. 3 | 6. 3 | 7. 3 | 8. 4 | 9. 4 | 10. 1 |
| 11. 3 | 12. 1 | 13. 2 | 14. 1 | 15. 3 | 16. 3 | 17. 3 | 18. 2 | 19. 2 | 20. 4 |
| 21. 2 | 22. 4 | 23. 1 | 24. 3 | 25. 4 | 26. 1 | 27. 4 | 28. 1 | 29. 1 | 30. 4 |
| 31. 1 | 32. 1 | 33. 3 | 34. 4 | 35. 3 | | | | | |

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PHYSICS

PART 3

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Measurements

SYNOPSIS

- The quantities which can be defined and measured are called physical quantities.

- The physical quantities which can be described by their magnitude only are called scalar quantities.

Example: Distance, mass, time, speed, density, etc.

- The physical quantities which can be described completely by both their magnitude and direction are called vectors.

Example: Force, velocity, acceleration, etc.

- The physical quantities are classified into two categories—fundamental quantities and derived quantities.

- The physical quantities that do not depend on any other physical quantity for their measurement are called fundamental quantities.

Mass, length, time, electric current, temperature, luminous intensity and amount of substance are the fundamental quantities.

- The physical quantities that are derived from the fundamental quantities are called the derived quantities. Area, volume, density, force, velocity, etc., are some examples of derived quantities.

- Measurement is a method of comparison of an unknown quantity with a known quantity.

- (i) F.P.S. system: In this system, the units of length, mass and time are foot, pound and second respectively.

- (ii) C.G.S. system: In this system, the units of length, mass and time are centimetre, gram and second respectively.

- (iii) M.K.S. system: In this system, the units of length, mass and time are metre, kilogram and second respectively.

- (iv) S.I. (System international d' unites): This system is an improved and extended version of M.K.S. system. This system defines seven fundamental quantities and two supplementary quantities.

- The nature of any physical quantity can be described by mentioning the powers to which the fundamental units are raised to give the unit of the given quantity. The three fundamental quantities mass, length and time are denoted by M, L and T respectively.

- The powers to which the units of fundamental quantities mass, length and time are raised to obtain the unit of a physical quantity is known as dimensions of the given quantity.

- Unit of density of a body

$$= \frac{\text{unit of mass}}{\text{unit of volume}} = \text{kg m}^{-3}$$

- Graph is a pictorial presentation of the variation of one quantity with respect to another quantity.

- **Errors and accuracy:** Degree of accuracy is the extent to which one can measure a quantity without any error.

There are two types of errors, considered, in general. They are

- (1) absolute error = True value – measured value.
- (2) relative error = $\frac{\text{Absolute error}}{\text{Actual value}}$. If the relative error is expressed in percentage, it is called percentage error.

Percentage errors: The percentage error is defined as Percentage error

$$= \frac{\text{Absolute error}}{\text{Actual value}} \times 100$$

- The **least count** of an instrument is the smallest measurement that can be made accurately with that instrument.

The principle of a vernier is to make 'N' vernier scale divisions equal to (N – 1) main scale divisions.

- \therefore Total reading = M.S.R. + (V.C.D. \times L.C.)
- Least count (L.C.) = $\frac{1 \text{ M.S.D.}}{\text{No of V.S.Ds}}$
- When the fixed and the movable jaws of a vernier calipers are made to come in contact and if the zeroes of both the main scale and the vernier scale are not coinciding with each other then instrument is said to have a **zero error**.
- If the zeroth division of the vernier scale is to the 'right' of the zeroth division of the main scale when the two jaws are brought in contact with each other, then the error is said to be positive and the correction is negative. If the n^{th} division of the vernier scale coincides with some division on the main scale, then the **zero error is (+ n \times Least count)** and the **correction is (– n \times Least count)**.
- If the zeroth division of the vernier scale is to the 'left' of the zeroth division of the main scale, the error is said to be negative and the correction is positive. If the n^{th} division of the vernier scale coincides with some division on the main scale, then the **zero error = – (N – n) \times Least Count** and the **correction = + (N – n) \times Least Count** where N is the number of divisions on the vernier scale.
- The screw gauge works on the principle of a screw in a nut. When the head of a screw rotates once completely the tip of the screw moves by a distance equal to the distance between the threads on it.

Distance moved by the thimble
on the main scale

- Pitch = $\frac{\text{Distance moved by the thimble on the main scale}}{\text{Number of rotations of the thimble}}$

- Least count = $\frac{\text{Pitch}}{\text{Number of Circular Scale Divisions}}$
- Observed measurement = Main scale reading + Circular Scale Reading \times L.C.
- When the stud and the tip of the screw of a screw gauge are made to come in contact, if the zeroes of both the main scale and the circular scale are not coinciding with each other, the instrument is said to have a **zero error**.
- **Positive zero error:** When the stud and the tip of the screw of a screw gauge are made to come in contact, if the zeroth division of the circular scale is 'below' the reference base line of the main scale, the error is said to be positive and the correction is negative. If n is the circular scale division coinciding with the index line of the main scale, then the Zero error = + n \times least count and the correction = – n \times least count
- When the stud and the tip of the screw of a screw gauge are made to come in contact, if the zeroth division of the circular scale is 'above' the reference line of the main scale, the error is said to be negative and the correction is positive. If n is the circular scale division coinciding with the index line of the main scale, then the
Zero error = – (N – n) \times least count and the correction = + (N – n) \times least count. Where 'N' is the total number of divisions on the *circular scale*.
- True measurement = Observed measurement + Correction for zero error
Observed measurement = (M.S.R.) + (C.S.R. \times L.C.)
- Physical balance is an instrument, working on the principle of moments, and is used in laboratories to determine the mass of substances/bodies more accurately than a common balance.
- Spring balance is a device used to measure the weight of a body. The spring balance works on the principle of Hooke's law – "the elongation in a spring is directly proportional to the force applied to it within its elastic limit".
- Microbalances are used to measure the mass of substances upto one microgram.
Electronic balances used in jewellery shops to display the accurate mass in digits on a screen.
Single pan analytical balance used in laboratories can measure the mass accurately upto 0.1 mg.
- Time is defined as the interval between two events. It is a fundamental quantity. The unit of time in S.I. system is second.

- 1 mean solar day = 24 hours; 1 hour = 1/24th part of the mean solar day
1 minute = 1/1440th part of the mean solar day; 1 second = 1/86400 of the mean solar day
1 year is the time in which the earth completes one complete revolution around the sun.
- A simple pendulum consists of a heavy sphere, called the bob, suspended freely from a fixed point by a light,

inextensible string enabling it to oscillate freely about the vertical mean position.

- The pendulum with a time period of 2 seconds is called seconds pendulum.
- Normally, the surface of a liquid is slightly curved near the walls of the container due to a phenomenon known as **surface tension**. This is particularly prominent in narrow tubes like the burette and pipette. This curved surface of the liquid is known as **meniscus**.
- The density of the solid is calculated using the expression, $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$

Solved Examples

1. If the conductance of a conductor (G) is $\frac{I^2 t}{W}$, where I is current, t is time and W is work done, then write the unit of conductance expressed in terms of fundamental units.

☞ **Solution:** $G = \frac{I^2 t}{W}$

$$\text{Unit of } G = \frac{\text{A}^2 \text{s}}{\text{J}} = \frac{\text{A}^2 \text{s}}{\text{kg m}^2 \text{s}^{-2}} = \frac{\text{A}^2 \text{s}^3}{\text{kg m}^2}$$

2. The percentage errors in the measurement of g and length of the pendulum (ℓ) are $\alpha\%$ and $\beta\%$ respectively, then what is the maximum error in measuring time period of the pendulum T.

☞ **Solution:** $1/2(\alpha + \beta)$

Error in measurement of g = $\alpha\%$.

Error in measurement of ℓ = $\beta\%$.

$$T \propto \sqrt{\frac{\ell}{g}}$$

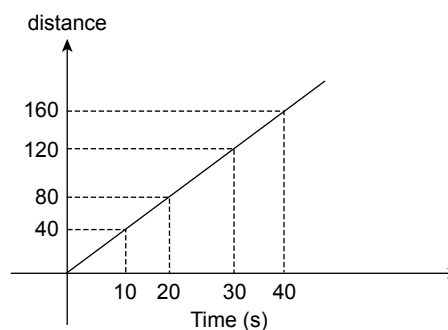
∴ Error in measurement of

$$T = \frac{1}{2} (\text{Error in measurement of } \ell + \text{Error in measurement of } g) = 1/2 (\alpha + \beta)\%.$$

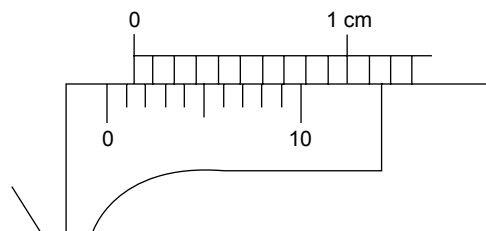
3. The distance travelled by a body in different time interval is tabulated as follows. Draw the distance time graph.

Time (s)	0	10	20	30	40
Distance (m)	0	40	80	120	160

☞ **Solution:**



4. Determine the least count and the zero error of the vernier calipers from the adjacent figure. What is the corresponding zero correction?



☞ **Solution:** Number of divisions on the Vernier scale = 10.

$$10 \text{ VSD} = 9 \text{ MSD}$$

$$\text{Least count} = 1 \text{ MSD} - 1 \text{ VSD}$$

$$= \frac{1 \text{ MSD}}{10} = \frac{1 \text{ mm}}{10} = 0.1 \text{ mm}$$

The 8th V.S. division coincides with the 6th M.S.D

$$\text{Zero error} = 6 \text{ M.S.D} - 8 \text{ VSD}$$

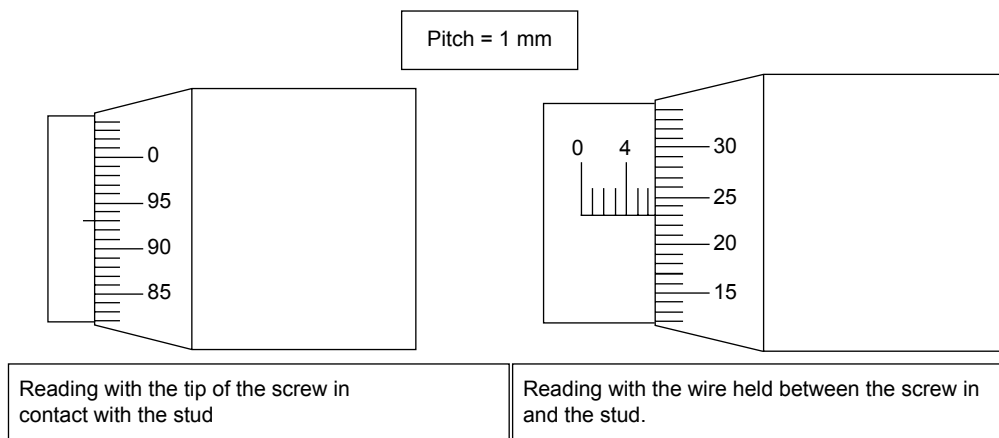
$$= 6 \text{ MSD} - \left(8 \times \frac{9}{10} \right) \text{ MSD} = (6 - 7.2) \text{ mm}$$

$$= -1.2 \text{ mm}$$

Thus the error is negative. This can also be concluded from the fact that the zero of the vernier scale lies to the left of the zero of the main scale.

$$\text{Zero correction} = +1.2 \text{ mm}$$

5. Find the area of cross-section of a rod, the diameter of which is measured with a screw gauge with readings as shown in the figure.



☞ **Solution:** Least count = $\frac{1 \text{ mm}}{100} = 0.01 \text{ mm}$

Determination of zero error:

The zero of the circular scale is above the index line, hence, the error is negative

$$\text{CCD} = 93$$

$$\text{Zero error} = - (100 - 93) \times 0.01 \text{ mm} = -0.07 \text{ mm}$$

$$\text{Correction} = +0.07 \text{ mm}$$

Observed reading

$$\text{P.S.R.} = 6 \text{ mm, CCD} = 23$$

$$\text{Observed diameter} = \text{PSR} + (\text{CCD} \times \text{LC})$$

$$= 6 \text{ mm} + (23 \times 0.01 \text{ mm}) = 6.23 \text{ mm}$$

$$\text{Correct diameter} = (6.23 + 0.07) \text{ mm} = 6.30 \text{ mm}$$

$$\text{Cross-section area} = \frac{\pi D^2}{4}$$

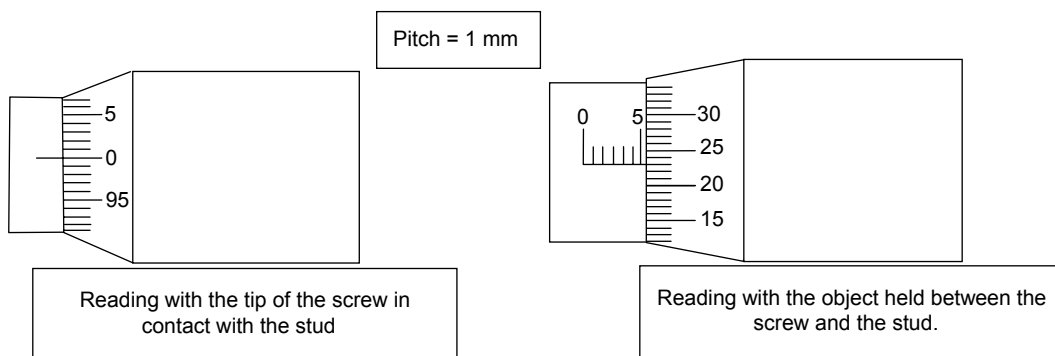
$$= \frac{22}{28} \times (6.30 \text{ mm}) \times (6.30 \text{ mm})$$

$$= 31.1850 \text{ mm}^2 = 31.19 \text{ mm}^2$$

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

- Write the SI unit of the physical quantity having following dimensional formula $[M^0 L^2 T^{-2} K^{-1}]$.
 (1) $m \text{ kg}^2 \text{ K}^{-1}$
 (2) $m^2 \text{ kg}^2 \text{ T}^{-1}$
 (3) $m^2 \text{ s}^{-2} \text{ K}^{-1}$
 (4) $m^2 \text{ kg}^2 \text{ K}^{-1}$
- A vernier calipers with 0.02 mm least count is to be constructed. If 1MSD = 0.5 mm how many divisions would the sliding scale have?
 (1) 10 (2) 25
 (3) 24 (4) 20
- The dimensional formula of a physical quantity is $[M^1 L^2 T^{-3} I^{-1}]$. What is its SI unit?
 (1) $\text{kg m}^2 \text{ s}^{-3} \text{ A}^{-1}$
 (2) $\text{kg m}^2 \text{ s}^2 \text{ A}$
 (3) $\text{kg ms}^{-3} \text{ A}^2$
 (4) $\text{kg}^2 \text{ m}^2 \text{ s}^3 \text{ A}^{-1}$
- In a system of units, a mass of 250 ml of water is taken as one unit mass, length of 250 mm is defined as one unit length and 1/12th of an hour as one unit time. If the units of mass, length and time in this system are called a cup, a span and a moment, one newton force is equivalent to _____ in this system.
 (1) $1.44 \times 10^5 \text{ cups spans moment}^{-2}$
 (2) $1.44 \times 10^4 \text{ cups spans moment}^{-2}$
 (3) $14.4 \times 10^6 \text{ cups spans moment}^{-2}$
 (4) $1.44 \times 10^6 \text{ cups spans moment}^{-2}$
- The diameter of a rod was found to be 23.7 mm using a standard vernier calipers. The M.S.R. and V.C.D. on another vernier calipers in which 1 M.S.D. = 0.5 mm and the least count is 0.05 mm are _____ divisions and _____ respectively.
 (1) 23, 7
 (2) 23, 14
 (3) 47, 4
 (4) 46, 14
- Which among the following is the correct notation of units?
 (1) Force = 10 Newton
 (2) Pressure = 20 N m^{-2}
 (3) mass = 5 m g
 (4) Force = 25 kg ms^{-2}
- The density of an object in SI system is 5000 kg m^{-3} . What is its relative density?
 (1) 5 (2) 50
 (3) 500 (4) 5000
- While measuring the width of a metal block using a vernier calipers, it is observed that the 49th division on the main scale coincides with the 7th division on the vernier scale. Given that 1 M.S.D. = 1 mm, 9 M.S.D. = 10 V.S.D. and the instrument is error-free, determine the width of the block.
 (1) 4.2 mm (2) 4.72 mm
 (3) 4.56 mm (4) 46.6 mm
- What is the corrected reading if the observed reading is 7 mm and if the 3rd division of the vernier scale coincides with the second division of the main scale when the jaws are in contact?
 (1) 7.7 mm (2) 8.6 mm
 (3) 9.5 mm (4) 4.3 mm
- A vernier calipers having zero error is used to determine the thickness of a hollow tube. While measuring the outer and inner diameter main scale readings are found to be 8 cm and 7 cm respectively and the vernier scale readings are 9 and 8 divisions respectively. If the number of vernier scale divisions is 10 and one MSD = 1 mm, determine the thickness of the tube.
 (1) 10.1 mm (2) 20.2 mm
 (3) 5.05 mm (4) 10.5 mm
- The readings of a screw gauge when the tip of the screw is in contact with the stud and the object placed between the screw and the stud is as shown in the figure.
 Find the diameter of the object if the pitch of the screw gauge is 1.0 mm and the number of circular scale divisions is 100.



- (1) 13.52 mm (2) 6.52 mm
(3) 6.23 mm (4) 7.85 mm
12. A screw gauge with a positive zero error of 5 divisions is used to find the thickness of a glass plate. When the glass plate is held between the two studs, the main scale reading is 5 mm and the head scale coinciding division is 25. If the least count of the screw gauge is 0.01 mm, find the thickness of the glass plate.
- (1) 5.2 mm (2) 6.5 mm
(3) 6.8 mm (4) 9.8 mm
13. (a) The head scale of a screw gauge has 200 divisions and its thimble moves by 0.5 mm along the main scale for one complete rotation of the screw. Find its least count.
- (1) 0.00025 cm (2) 0.00025 mm
(3) 0.025 mm (4) 0.025 cm
- (b) While measuring the thickness of a glass plate using a screw gauge, the main scale reads 2 mm and head scale coinciding division is 57. If the least count of the screw gauge is 0.01 mm, find out the thickness of glass plate. (Zero error of the screw gauge is zero).
- (1) 3.78 mm (2) 2.57 mm
(3) 4.25 mm (4) 2.23 mm
14. A screw gauge has a least count equal to 0.0005 mm. The spindle of the gauge advances 0.1 mm, when the screw is turned through 2 revolutions. Then the thimble of the screw gauge contains _____ divisions.
- (1) 50 (2) 100
(3) 150 (4) 200
15. A student measures the thickness of a copper wire using standard instruments and reports it as 0.1 cm, 0.15 cm and 0.157 cm. The instruments used to find these measurements are _____, _____ and _____ respectively.
- (1) vernier callipers, ordinary scale, screw gauge
(2) ordinary scale, vernier callipers, screw gauge
(3) screw gauge, vernier calipers, ordinary scale
(4) ordinary scale screw gauge, vernier callipers
16. If the pitch of the screw is doubled by keeping the number of head scale divisions same, how does its least count vary?
- (1) remains same (2) doubled
(3) tripped (4) guatrappled
17. Find the zero error of the screw gauge given in the figure.
-
- (1) -0.02 mm (2) 0.02 mm
(3) 0.98 mm (4) -0.98 m
18. When the thimble of a screw gauge is given 20 complete rotations the tip of the screw advances 40 main scale divisions. When the studs of the screw gauge are in contact, the 95th division of the head scale is on the index line. When the object is placed between the jaws the edge of the head of the screw is on the right of 6th division of the main scale and the 72nd division of the head scale is on the index line. Determine the length of the object.
- (1) 7.54 mm (2) 7.35 mm
(4) 7.85 mm (4) 8.02 mm
19. 1 newton = _____ dyne.
- (1) 10^3 (2) 10^7
(3) 10^5 (4) 10^8

20. In a vernier calipers, 20th division on the vernier scale coincides with seventeenth division on the main scale. If 1 cm on the main scale is divided into 20 equal parts, then what is the least count of the calipers.

(1) 0.085 mm (2) 0.0075 mm
(3) 0.0075 mm (4) 0.075 mm

21. (a) The pitch of a screw gauge is 0.5 mm and its least count is 0.01 mm. Find the number of divisions on the head scale.

(1) 50 (2) 100
(3) 200 (4) 500

(b) When the tip of the screw of a screw gauge is in contact with the stud, 96th head scale division coincides with the base line. If the least count of this screw gauge is 0.01 mm then find out the correction to be made on the observations. (Take number of divisions on the head scale as 100).

(1) -0.04 mm (2) 0.4 mm
(3) 0.04 mm (4) 0.09 mm

22. If the pitch of the screw of a screw gauge is $\frac{1}{2}$ mm and number of head scale divisions is 100, what is the least count?

(1) 0.05 mm
(2) 0.005 mm
(3) 0.05 cm
(4) 0.08 mm

23. A screw gauge has 500 divisions on its head scale and the head scale moves 5 mm when rotated 10 times, then determine the pitch and least count of the screw gauge.

(1) 0.001 cm
(2) 0.01 cm
(3) 0.001 mm
(4) 0.1 mm

24. What is the dimensional formula of universal gravitational constant 'G'? The gravitational force of attraction between two objects of masses m_1 and m_2

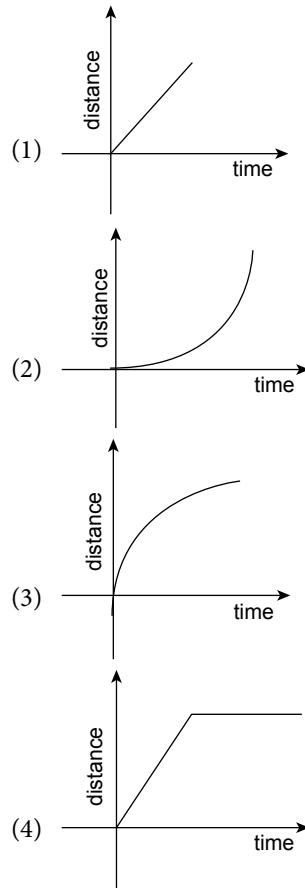
separated by a distance d is given by $F = \frac{G m_1 m_2}{d^2}$

Where 'G' is the universal gravitational constant.

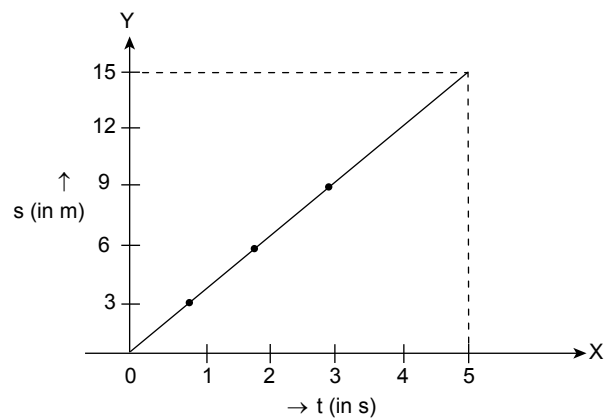
(1) $[M L T^{-2}]$ (2) $[M^{-1} L^2 T^2]$
(3) $[M^{-1} L^3 T^{-2}]$ (4) $[M^2 L^2 T^{-2}]$

25. The distance travelled by a body in different time interval is tabulated as follows. Which among the following is the distance time graph?

Time (s)	0	10	20	30	40
Distance (m)	0	40	80	120	160



26. A displacement-time graph of a body moving with uniform velocity is shown in the figure. Find out its velocity and its displacement at the end of 5 seconds.



(1) 125 m (2) 225 m
(3) 15 m (4) 75 m

27. The value of $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ and $g = 9.8 \text{ ms}^{-2}$. What is the unit of g/G in C.G.S system?

(1) g cm^{-2} (2) g cm^2
(3) g cm^{-1} (4) g cm

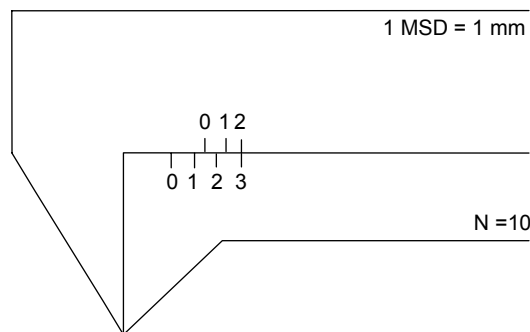
28. If the distance between two consecutive threads of a screw is 0.05 cm, the pitch of the screw is _____ mm.

(1) 0.01 (2) 0.1
(3) 0.05 (4) 0.5

29. If N divisions on the vernier scale are equal to $(N - 2)$ divisions on the main scale, then the least count is _____.

(1) $\frac{1\text{MSD}}{N}$ (2) $\frac{2\text{MSD}}{N}$
(3) $\frac{\text{MSD}}{2N}$ (4) $\frac{1\text{MSD}}{N^2}$

30. Determine the zero error and least count of a vernier calipers shown below.



(1) 0.007 mm (2) 0.07 mm
(3) 0.7 mm (4) 0.7 cm

31. A vernier calipers has 20 divisions on vernier scale and its M.S.D is 0.5 mm. When a hollow cylinder is held by its internal jaws the M.S.R and V.C.D of calipers are 1.2 cm and 10 respectively. Find the radius of cross section of the cylinder.

(1) 0.355 mm (2) 6.325 mm
(3) 0.6125 mm (4) 0.6125 cm

32. A rectangular metal sheet of area 2 m^2 is rolled to form a cylinder of volume $\frac{4}{\pi} \text{ m}^3$. Then the radius of the cylinder thus formed is _____ m.

(1) $4/\pi$ (2) $\pi/4$
(3) π (4) π^2

33. The ZRP of a physical balance is 10.5 while finding mass of a substance. For a weight 34.23 g the resting point was found to be 8.5. when 10 mg was removed the resting point was 11.0. The most accurate mass of the substance is _____ g.

(1) 34.156
(2) 34.312
(3) 34.338
(4) 34.222

34. In a triple beam balance the calibration on the three beams are 0 – 3 kg, 0 – 100 g and 0 – 10 g. What is the maximum mass that can be measured by the balance?

(1) 3110 g (2) 3100 g
(3) 310 g (4) 3000 g

35. If T is the time period of a seconds pendulum, measured in seconds. How many T makes one minute?

(1) 20 T (2) 60 T
(3) 30 T (4) 40 T

36. To determine the weight of a solid body lighter than water, a sinker is used. The solid body of density 0.5 g cm^{-3} is tied to the sinker of the volume 50 cm^3 and the combination is immersed into the water. If the volume of water displaced is 80 cm^3 , find the weight of the body.

(1) 120 gwt (2) 60 gwt
(3) 30 gwt (4) 15 gwt

37. A standard screw gauge has a negative error of 7 divisions. While measuring the diameter of a wire the reading on the main scale is 2 divisions, and the 72nd circular scale division coincides with the base line. If the divisions on the main scale are 10 to a centimetre and the circular scale has 100 divisions, then calculate the correct diameter.

(1) 2.74 mm (2) 2.79 mm
(3) 2.35 mm (4) 1.53 mm

38. A student measures the thickness of an object using three different instruments and gets the results as 0.5 cm, 0.50 cm, and 0.500 cm. State the one which is most accurate.

(1) 0.5 cm
(2) 0.50 cm
(3) 0.500 cm
(4) All the measurements are equally accurate

39. In a system of units, the units of mass, length and time are called pail, jack and jill. 1 pail = 5 kg, 1 m = 5 jacks and 24 s make 1 jill.

What are the units of density and speed in the new system?

- (1) (pails) (jills)⁻² (2) (pails) (jack)⁻³
 (3) (jack)² (jill) (4) (pails) (jack)²

40. The working of common balance or physical balance is based on the "Principle of moments". A

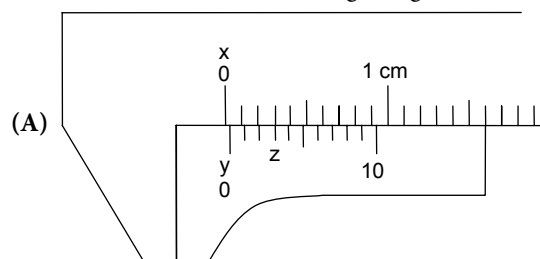
metre scale of uniform density is balanced at the centre. If a mass of 2 kg is suspended at an edge of the scale, then what mass should be suspended on other side at 1/4th length of the scale to maintain the horizontal position of the scale?

- (1) 400 g (2) 40 kg
 (3) 4 kg (4) 2 kg

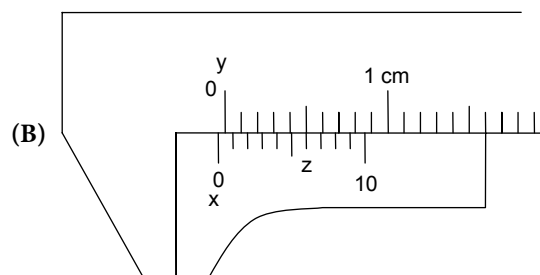
PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Find the zero error in the two figures given.



- (1) 0.3 mm (2) -0.3 mm
 (3) -0.7 mm (4) 0.7 mm

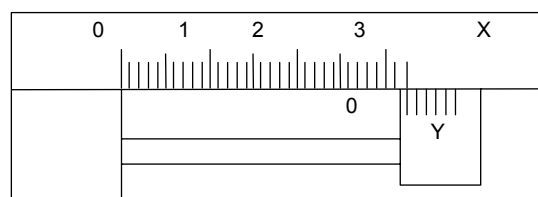


- (1) -0.4 mm (2) 0.4 mm
 (3) 0.6 mm (4) 0.6 m

2. While measuring the inner diameter and outer diameter of a hollow tube to determine its thickness by using a vernier callipers, the main scale readings are found to be 20 mm and 60 mm respectively. What are the minimum and maximum possible thickness if one main scale division = 1 mm, number of vernier scale division = 10?

- (1) 39.1 mm, 40.25 mm
 (2) 60 mm, 90 mm
 (3) 20.9 mm, 21.45 mm
 (4) 19.5 mm, 20.45 mm

3. Determine the length of the object from the following diagram. 1 division on scale X is 1 mm and 10 divisions on scale Y is equal to 9 mm.



- (1) 36.2 mm (2) 31.1 mm
 (3) 42.5 mm (4) 56.2 mm

4. If 1 mile = 1.6 km and 8 furlongs make 1 mile, then the distance of 20 km = _____ furlongs.

- (1) 25 (2) 510
 (3) 100 (4) 20

5. The dimensional formula of a physical quantity is $[M^1L^1T^{-2}]$. What is its SI unit?

- (1) $\text{kg s}^{-2} \text{m}^{-1}$
 (2) kg ms^{-2}
 (3) $\text{kg}^2 \text{s}^2 \text{m}^2$
 (4) kg ms^2

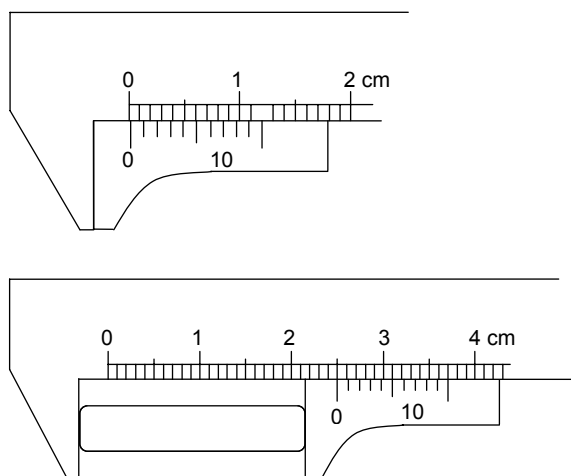
6. The densities of three objects A, B and C are 2 g cm^{-3} , 1000 kg m^{-3} and 4 g m^{-3} respectively. Arrange them in the ascending order.

- (1) A B C (2) C B A
 (3) A C B (4) B A C

7. While measuring the length of cap of a pen using a vernier calipers, it was found to be 5.40 cm. The 5th division on vernier scale was found to coincide with a division on the main scale. The least count of the vernier calipers is 0.01 cm and zero error is -0.05 cm then determine the main scale reading.

- (1) 5.6 mm (2) 5.3 cm
 (3) 4.3 cm (4) 2.4 cm

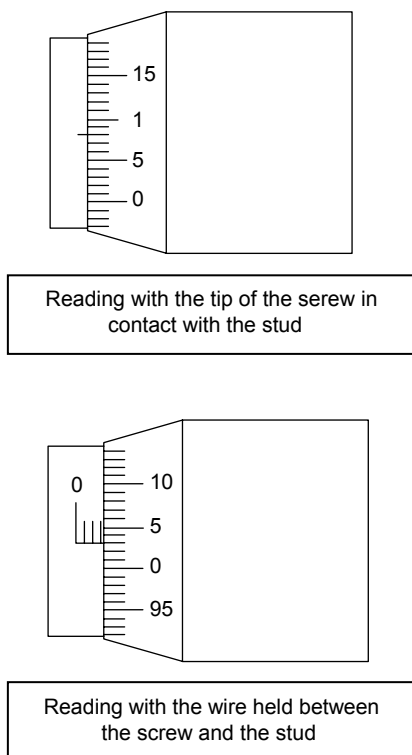
8.



What is the length of the rod shown in the figure?

- (1) 13.75 cm (2) 37.5 cm
(3) 12.5 cm (4) 2.47 cm

9.



The readings of a screw gauge when an object is placed between the stud and the tip of the screw is as shown above. If the pitch of the screw is 1 mm, the diameter of the object is ____ mm.

- (1) 2.95 (2) 29.5
(3) 3.11 (4) 31.1

10. A screw gauge with 0.5 mm pitch and 5 μm least count is used to determine the diameter of a wire. If the head scale reading is 72 and the diameter of the wire measured is 350 microns, the zero error of the instrument is ____.

- (1) $10 \times 10^{-3} \mu\text{m}$ (2) 0.01 cm
(3) $10 \times 10^{-6} \text{ m}$ (4) None of these

11. While measuring the thickness of a glass plate using a screw gauge, the main scale reads 2 mm and head scale coinciding division is 57. If the least count of the screw gauge is 0.01 mm, find out the thickness of glass plate. (Zero error of the screw gauge is zero)

- (1) 2.57 mm (2) 6.25 mm
(3) 3.25 mm (4) 16.3 mm

12. The head scale of a screw gauge has 200 divisions and its thimble moves by 0.5 mm along the main scale for one complete rotation of the screw. Find its least count.

- (1) 0.00025 (2) 0.005
(3) 0.025 (4) 0.0025

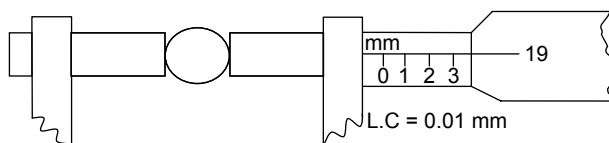
13. A screw gauge has a pitch equal to 0.1 mm. How many divisions must be there on its head so as to measure accurately upto 0.0005 mm?

- (1) 200 (2) 100
(3) 500 (4) 1000

14. When the studs of a faulty standard screw gauge are in contact, it has 30 divisions of circular scale lying above the index line of the pitch scale. Then the zero correction is ____ cm.

- (1) 0.004 (2) 0.3
(3) 0.03 (4) 0.04

15. Determine the diameter of the object from the following diagram.



- (1) 3 mm (2) 31.9 mm
(3) 3.19 mm (4) 49.01 mm

16. While measuring the diameter of a lead shot using screw gauge, the pitch scale reading and the head scale reading were found to be 4.0 mm and

- 50 respectively. If the least count of the instrument is 0.01 mm and zero error is -0.45 mm, then what is the diameter of the lead shot?
- (1) 3.12 mm (2) 4.65 mm
(3) 4.95 mm (4) 49.8 mm
17. The percentage errors in the measurement of the length (L) and breadth (B) of a rectangle are $\ell\%$ and $b\%$ respectively. Then the percentage error in the calculation of the area will be ____.
- (1) $(\ell b)\%$ (2) $(1 + b)\%$
(3) $(L + l)(B + b)$ (4) $Lb + BL$
18. Velocity gradient is defined as “change in velocity per unit distance”. Then its unit in F.P.S. system is ____.
- (1) foot s^{-1} (2) s^{-1}
(3) foot s (4) pound s
19. The distance between two places is 25 km. Write the magnitude of the measurement.
- (1) km (2) distance
(3) 25 (4) two
20. While measuring the diameter of a sphere with a vernier calipers if MSR and VCD are 35 mm and 5 respectively and if the vernier scale consists of 20 divisions and 1 MSD is 1 mm then what is the diameter of sphere?
- (1) 64.35 mm (2) 35.25 mm
(3) 1.95 mm (4) 40.25 mm
21. When the jaws of a vernier calipers are closed, the zeroth division of its vernier scale is to the right of the zero of the main scale and the V.C.D is 6. Find the correction to be made to the observed measurement (take its least count as 0.1 mm).
- (1) -0.3 mm (2) 0.3 mm
(3) 0.6 mm (4) -0.6 mm
22. In a vernier calipers, the zero of the vernier scale is to the left of the zero of the main scale when the movable jaw is in contact with the fixed jaw. If the seventh division on the vernier scale coincides with the 5th division on the main scale, determine the zero error. Take 1 MSD = 1 mm, and 20 VSD = 19 MSD.
- (1) -6.5 mm (2) 16.5 mm
(3) -1.65 mm (4) 1.65 mm
23. When the jaws of a standard vernier calipers are closed, if the n^{th} division of the vernier scale coincides with the n^{th} M.S.D, the zero error is ____.
- (1) n^2 L C (2) $(n + 1)$ LC
(3) $(n - 1)$ L.C (4) $n \times L . C$
24. If the distance between two consecutive threads of a screw is 1 mm, the pitch of the screw is ____ mm.
- (1) 0.5 cm (2) 1 mm
(3) 0.1 mm (4) 0.5 mm
25. The least count of a screw gauge having 1 mm pitch and 100 circular scale divisions is ____ μm .
- (1) 100 (2) 10
(3) 1 (4) 0.0001
26. The least count of a vernier calipers is 0.01 cm and if the zero mark of the vernier scale is to the right of zero of the main scale and the vernier coincidence is 7 when the jaws are in contact, then the zero error is ____ cm.
- (1) $+6 \times 0.01$ (2) $+7 \times 0.01$
(3) -7×0.01 (4) -6×0.01
27. The head scale of a screw gauge has 200 divisions. Its head advances by 1 mm for each 2 complete rotations of its head. Find its least count.
- (1) 0.0025 mm (2) 0.056 mm
(3) 0.025 mm (4) 0.0342 mm
28. A screw gauge has a positive error of 4 divisions. When this screw gauge holds a sphere the main scale reading is 4 mm and the head scale coinciding division is 24. If its least count is 0.01 mm, the volume of the sphere is ____ mm^3 .
- (1) 24.456 (2) 38.808
(3) 62.378 (4) 40.567
29. In a spring balance, the extension of spring is ____ the magnitude of the weight (force) applied on it.
- (1) triple (2) double
(3) proportional to (4) none
30. In a spring balance, the distance on the scale between the marking for the minimum mass (zero kilogram) and that for the maximum mass (5 kg) is 6 cm. When certain body is suspended from the hook of this balance the needle moves down by 1.2 cm, then the mass of the body is ____ kg.
- (1) 3 (2) 2
(3) 4 (4) 1
31. The reading obtained while measuring the weight of an object is tabulated as shown below. Determine the weight of the object.
- | | | | |
|-------------------|---------------|---------|---------|
| Resting point | 7 | 8.5 | 6.5 |
| Weight in the pan | 0 | 12.25 g | 12.29 g |
| (1) 12.123 g | (2) 12.2575 g | | |
| (3) 12.1561 g | (4) 12.354 g | | |

- it displaces 600 g of the liquid. Then the density of the liquid is _____ kg m^{-3} .

PRACTICE EXERCISE 1 (A)

- | | | | | | | | | | |
|-------|-----------|-----------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 2 | 3. 1 | 4. 4 | 5. 3 | 6. 4 | 7. 1 | 8. 1 | 9. 1 | 10. 3 |
| 11. 3 | 12. 1 | 13. (a) 1 | (b) 2 | 14. 2 | 15. 2 | 16. 2 | 17. 1 | 18. 1 | 19. 3 |
| 20. 2 | 21. (a) 1 | (b) 3 | 22. 2 | 23. 3 | 24. 3 | 25. 1 | 26. 3 | 27. 1 | 28. 4 |
| 29. 2 | 30. 3 | 31. 4 | 32. 1 | 33. 4 | 34. 1 | 35. 3 | 36. 4 | 37. 2 | 38. 3 |
| 39. 2 | 40. 3 | | | | | | | | |

PRACTICE EXERCISE 1 (B)

- [illegible]

Kinematics

SYNOPSIS

- Mechanics is the branch of physics that deals with the effect of forces on matter. Statics, kinematics and dynamics are its different branches.
- **Statics:** It deals with bodies at rest under the action of forces.
- **Dynamics:** Dynamics deals with behaviour of the bodies under the action of forces causing their motion.
- **Kinematics:** It deals with the motion of bodies without considering the cause of motion.
- **Distance:** It is the length of the path from the initial position to the final position, traced by the particle while in motion. It is a scalar quantity and is path dependent.
- **Displacement:** It is a straight line connecting the initial and the final positions of a body in motion in a given time interval.
Displacement is a vector quantity, and is independent of the path.
- Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{s}{t}$
- **Uniform speed:** A particle is said to be moving with uniform speed, if it covers equal distances in equal intervals of time.
- A body moving with uniform velocity is in motion along a straight line path with a constant speed.
- Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$
- acceleration, $\vec{a} = \frac{\text{Change in velocity}}{\text{Time}} = \frac{\vec{v} - \vec{u}}{t}$
- If the velocity decreases with time, it is called as deceleration or retardation.
- The equations of motion are
 - (i) $v = u + at$
 - (ii) $s = ut + \frac{1}{2} at^2$
 - (iii) $v^2 = u^2 + 2as$
 - (iv) $S_n = u(1s) + a(n - 1/2)(1s)$
- The equations of motion for a body moving vertically under the influence of gravity are
 - (1) $v = u \pm gt$
 - (2) $s = ut \pm \frac{1}{2} gt^2$
 - (3) $v^2 = u^2 \pm 2gs$
- Equations of motion for a freely falling body
 - (1) $v = gt$
 - (2) $h = \frac{1}{2} gt^2$
 - (3) $v^2 = 2gh$
- Considering the upward direction as positive the equations of motion for a body projected vertically upwards are obtained by substituting 'h' for 's' and '-g' for 'a' as follows.
 - (1) $v = u - gt$
 - (2) $h = ut - \frac{1}{2} gt^2$
 - (3) $v^2 = u^2 - 2gh$

- Maximum height reached by a body projected vertically upwards

At the maximum height, $v = 0$

∴ From $v^2 = u^2 - 2gh$ we get,

$$0 = u^2 - 2g h_{\max} \Rightarrow h_{\max} \text{ or } H = \frac{u^2}{2g}$$

Time of ascent (t_a): It is the time taken by a body, projected vertically upwards, to reach the maximum height.

At maximum height the final velocity of the body, $v = 0$.

From the equation,

$$v = u + at, \text{ we get } 0 = u - gt_a \Rightarrow t_a = \frac{u}{g}$$

- **Time of descent (t_d):** It is the time taken by a body, projected vertically upwards, to reach the point of projection from its position of maximum height. $t_d = \frac{u}{g}$
- the time of ascent is always equal to the time of descent.
- **Time of flight (T):** It is the total time taken by a body projected vertically upwards to reach the position of maximum height and then return to the point of projection. $T = \frac{2u}{g}$

- The magnitude of the velocity with which the body reaches the ground is equal to the magnitude of the velocity with which it is projected vertically upwards.

- At any point, the upward velocity in its motion is equal to the downward velocity at the same point.

- **Projectile motion:** Any object which is thrown obliquely with a certain initial velocity and whose path is determined by the gravitational force is called a projectile.

- For a body projected obliquely making an angle θ with the horizontal, its vertical velocity is $u \sin \theta$ and horizontal velocity is $u \cos \theta$.

- The horizontal distance covered in t s is $(u \cos \theta)t$.

- The maximum horizontal distance covered by a projectile is called range R which it covers in a time ' t ' equal to time of flight, t_f . Thus

$$R = u \cos \theta \times t_f = \frac{u^2 \sin 2\theta}{g}$$

- The maximum height attained by the projectile is given by

$$H_{\max} = \frac{u^2 \sin^2 \theta}{2g}$$

- The trajectory of a projectile is a parabola.

Solved Examples

1. Two cars arrive at certain point with velocities of 30 ms^{-1} , 25 ms^{-1} and travel in a straight line with uniform acceleration 0.25 ms^{-2} and 0.5 ms^{-2} respectively.

(A) Find the distance at which they meet again.

(B) Also determine the time after which the final velocity one of the cars is equal to the initial velocity of the other.

☞ **Solution:** (A) Both cars travel for same time(t)

First car

$$u = 30 \text{ ms}^{-1}; a = 0.25 \text{ ms}^{-2}$$

$$S_1 = (30 \times t) + \frac{1}{2} (0.25 \times t^2)$$

Second car

$$u = 25 \text{ ms}^{-1}$$

$$a = 0.5 \text{ ms}^{-2}$$

$$S_2 = (25 \times t) + \frac{0.5}{2} t^2$$

$$\text{But } s_1 = s_2$$

$$\therefore 30t + \frac{1}{2} 0.25 t^2$$

$$= 25t + \frac{1}{2} 0.5t^2 = 10t = 0.25t^2$$

$$t = \frac{10}{0.25} = 40 \text{ s}$$

Length of the path travelled

$$(S) = (30 \times 40) + \frac{0.25}{2} \times (40)^2$$

$$= 1200 + 200 = 1400 \text{ m.}$$

$$(B) \quad v = 30 \text{ ms}^{-1}, u = 25 \text{ ms}^{-1}$$

$$a = 0.5 \text{ ms}^{-2}, t = ?$$

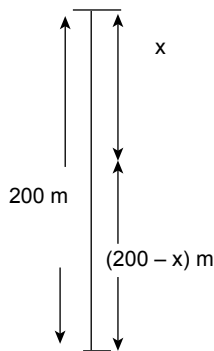
$$v = u + at \Rightarrow 30 = 25 + 0.5 \times t$$

$$\Rightarrow 5 = 0.5 t \Rightarrow t = 10 \text{ s}$$

2. A stone is dropped by a person from the top of a tower, which is 200 m tall. At the same time, another stone is thrown upwards, with a velocity of 50 ms^{-1} by a person standing at the foot of the tower. Find the time after which the two stones meet.

Solution: Let the two stones meet at a distance of x m from the top of the tower, and 't' be the time taken. Let us assume the downward direction as positive.

For the stone, that is dropped, its initial velocity $u = 0 \text{ ms}^{-1}$; displacement $s = x$ and acceleration = acceleration due to gravity (g).



Using $s = ut + \frac{1}{2}at^2$,

we get $x = (0)t + \frac{1}{2}gt^2 \rightarrow (1)$

For the stone that is projected vertically upwards, its initial velocity, $u = -50 \text{ ms}^{-1}$; displacement $s = - (200 - x)$ and acceleration $a = g$.

Using $s = ut + \frac{1}{2}at^2$

we get $-(200 - x) = -50 \times t + \frac{1}{2}gt^2$
 $200 = 50t - \frac{1}{2}gt^2 + x \rightarrow (1) (2)$

From the equations (1) and (2),

we have $200 = 50t - \frac{1}{2}gt^2 + \frac{1}{2}gt^2$
 $\Rightarrow 200 = 50t \therefore t = 4 \text{ s}$

3. A small steel ball is dropped from a height of 2.5 m into a tall glycerine jar. It hits the surface of glycerine with certain velocity and sinks to it. When it reached the bottom its velocity is found to be 80% of its velocity at the surface. If the time taken to reach the bottom after it is dropped is 2 s and velocity in glycerine is lost at a constant rate, then find the average velocity of the ball over the whole journey.

Solution: The body falls freely under gravity before hitting the glycerine surface. To find the time taken by the body to reach the glycerine surface (t_1) after being dropped, use $t = \sqrt{\frac{2h}{g}}$

face (t_1) after being dropped, use $t = \sqrt{\frac{2h}{g}}$

substitute $h = 2.5 \text{ m}$, $g = 9.8 \text{ ms}^{-2}$;

$$t_1 = \sqrt{\frac{2 \times 2.5}{9.8}} = \sqrt{\frac{25}{49}} = \frac{5}{7} \rightarrow (1)$$

The velocity on reaching the glycerine surface,

$$V = \sqrt{2gh}$$

substitute $g = 9.8 \text{ ms}^{-2}$, $h = 2.5 \text{ m}$

$$V = \sqrt{2 \times 9.8 \times 2.5} = \sqrt{\frac{4 \times 49 \times 25}{100}} = \frac{2 \times 7 \times 5}{10} = 7 \text{ ms}^{-1} \rightarrow (2)$$

The time (t_2) taken by the body to reach the bottom of glycerine surface

$$t_2 = 2 - t_1 = 2 - \frac{5}{7} = \frac{14-5}{7} = \frac{9}{7} \dots \rightarrow (3)$$

To find the distance covered by the body in glycerine, use $S_g = \frac{V+u}{2} \times t$

Substitute $V = 80\%$ of velocity at the surface

$$= \frac{8}{10} \times 7 \text{ (from eqn (2))} = 5.6 \text{ ms}^{-1}$$

$$S_g = \frac{7+5.6}{2} \times \frac{9}{7} = \frac{12.6}{2} \times \frac{9}{7} = 6.3 \times \frac{9}{7} = 0.9 \times 9$$

$$= 8.1 \text{ m} \rightarrow (4)$$

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{2.5+8.1}{2} = \frac{10.6}{2} = 5.3 \text{ ms}^{-1}.$$

4. A stone, projected up vertically with a velocity v , reaches points x , y and z in its path with velocities $\frac{v}{\sqrt{5}}$, $\frac{v}{\sqrt{10}}$ and $\frac{v}{\sqrt{15}}$ respectively. Find the ratio $xy : yz$.

Solution: The distance travelled between $xy = \frac{v^2 - u^2}{2(-g)}$,

$$\text{where } v = \frac{v}{\sqrt{10}}, u = \frac{v}{\sqrt{5}}$$

$$\therefore xy = \frac{\left(\frac{v}{\sqrt{10}}\right)^2 - \left(\frac{v}{\sqrt{5}}\right)^2}{-2g}$$

$$= \frac{v^2}{-2g} \left[\frac{1-2}{10} \right] = \frac{v^2}{20g}$$

$$\text{Similarly, } yz = \frac{\left(\frac{v}{\sqrt{15}}\right)^2 - \left(\frac{v}{\sqrt{10}}\right)^2}{-2g}$$

$$= \frac{v^2}{-2g} \left[\frac{2-3}{30} \right] = \frac{v^2}{60g}$$

$$\therefore \frac{xy}{yz} = \frac{v^2}{20g} \times \frac{60g}{v^2} = 3 : 1$$

5. When a body is dropped from a tower, it covers 75% of the total height of the tower in the last second of its fall. What is the total height of the tower?

☞ **Solution:** Let h be the height of the tower the initial velocity $u = 0$

$$h = \frac{1}{2}gt^2 \quad \dots (1)$$

$$S_n = \frac{g}{2} (2t - 1) = 0.75 h$$

$$= \frac{g}{2} (2t - 1) = 0.75 \left(\frac{1}{2}gt^2 \right) \text{ (from (1))}$$

$$2t - 1 = \frac{75t^2}{100} = \frac{3}{4}t^2$$

$$8t - 4 = 3t^2$$

$$3t^2 - 8t + 4 = 0$$

$$t = \frac{8 \pm \sqrt{64 - 4 \times 3 \times 4}}{2 \times 3} = \frac{8 \pm \sqrt{16}}{12} = \frac{8 \pm 4}{12}$$

$$t = 1, -2/3 \Rightarrow t = 1 \text{ s}$$

$$h = \frac{1}{2} \times g t^2 = \frac{1}{2} \times 9.8 \times 1 = 4.9 \text{ m}$$

6. A hot air balloon, released from the ground, moves up with a constant acceleration of 5 ms^{-2} . A stone is released from it at the end of 8 seconds.

Find the height of the stone from the ground at the end of 8 seconds after it is released from the balloon. (Take $g = 10 \text{ ms}^{-2}$)

☞ **Solution:** The velocity of the stone, when it is released from the balloon is given by $v = u + at$ and is equal to the velocity of the balloon. Consider downward direction as positive and substitute, $v = ?$, $u = 0$, $a = -5 \text{ ms}^{-2}$, $t = 8$

$$v = -5 \times 8 = -40 \text{ ms}^{-1} \quad \dots (1)$$

The displacement of the stone after 8 s is

$$s = -ut + \frac{1}{2}gt^2$$

Substituting $s = h$, $u = -40 \text{ ms}^{-1}$,

$$t = 8 \text{ s}, g = 10 \text{ ms}^{-2}$$

$$h = -40 \times 8 + \frac{1}{2} \times 10 \times 8^2$$

$$h = -320 + 320 \quad h = 0.$$

i.e., the stone returns back to the position from where it was released, i.e., the height of the balloon from the ground at the end of 8 seconds

$$S = ut + \frac{1}{2}at^2$$

substitute $u = 0$,

$$a = -5 \text{ ms}^{-2}, t = 8 \text{ s}$$

$$s = -\frac{1}{2} \times 5 \times 8 \times 8 = -5 \times 4 \times 8$$

$$s = -160 \text{ m}$$

\therefore The height of the balloon from the ground is 160 m.

7. A body takes ' t ' seconds to reach a maximum height ' H ' m, when projected vertically upward from the ground. Find the position of the body after $\frac{t}{2}$ seconds from the ground in terms of H .

☞ **Solution:** Let ' h ' be the height attained by the body in $\frac{t}{2}$ second $s = ut - \frac{1}{2}gt^2$

$$\text{Substituting } s = h, t = \frac{t}{2}$$

$$h = u \times \frac{t}{2} - \frac{1}{2}g\left(\frac{t^2}{4}\right) \quad \dots (1)$$

$$H = \frac{u^2}{2g} \Rightarrow u = \sqrt{2gH} \quad \dots (2)$$

$$t = \frac{u}{g} = \frac{\sqrt{2gH}}{g} \quad \dots (3)$$

Substituting (2) and (3) in (1)

$$h = \sqrt{2gH} \times \frac{\sqrt{2gH}}{2g} - \frac{g}{2} \times \frac{2gH}{4g^2} = \frac{2gH}{2g} - \frac{H}{4}$$

$$= H - \frac{H}{4} = \frac{3}{4}H$$

8. A ball is dropped from a height of 45 m. Two seconds later, another ball is thrown downward from the same height. If both hit the ground simultaneously, find the difference between velocities of the two balls, just before hitting the ground. (Take $g = 10 \text{ ms}^{-2}$)

Solution: The velocity of the first ball on reaching the ground is given by $v_1 = \sqrt{2gh}$.

Substituting $g = 10 \text{ ms}^{-2}$ and $h = 45 \text{ m}$ we get

$$v_1 = \sqrt{2 \times 10 \times 45} = \sqrt{900} = 30 \text{ ms}^{-1} \text{ ----- (1)}$$

The time taken by the first ball to reach the ground, $t = \frac{v_1}{g}$. Substituting the value of v_1 , we

$$\text{get } t = \frac{30}{10} = 3 \text{ s}$$

Hence, the time taken by the second ball to reach the ground = $3 - 2 = 1 \text{ s}$ ----- (2)

To find the initial velocity v_2 of the second ball, we use the formula $s = ut + \frac{1}{2}gt^2 \Rightarrow s = v_2 t - \frac{1}{2}gt^2$

Substituting $s = 45 \text{ m}$

$$t = 1 \text{ second, } v_2 = ?$$

$$45 = -v_2 \times 1 - \frac{1}{2} \times 10 \times 1^2$$

$$v_2 = 45 + 5 = 50 \text{ ms}^{-1} \text{(3)}$$

$$\text{Difference in the velocity} = v_2 - v_1$$

$$= 50 \text{ ms}^{-1} - 30 \text{ ms}^{-1} = 20 \text{ ms}^{-1}$$

9. A missile is launched from the ground, making an angle of 45° with the ground, so as to hit an aeroplane which is moving horizontally at a height of 840 m. If the missile hit the target at a horizontal distance 1 km from it, find the speed with which the missile was launched. (Take $g = 10 \text{ ms}^{-2}$).

Solution: For horizontal motion of the missile, we can write

$$x = u \cos \theta \times t, \text{ Substituting } x = 1000 \text{ m, } \theta = 45^\circ$$

$$\text{we get } 1000 = u \cos 45^\circ \times t$$

$$1000 = \frac{ut}{\sqrt{2}}; ut = 1000\sqrt{2} \rightarrow (1)$$

For vertical motion of the missile, we can write

$$y = u \sin \theta \times t - \frac{1}{2}gt^2;$$

$$\text{Substitute } y = 840 \text{ m, } \theta = 45^\circ; g = 10 \text{ ms}^{-2}$$

$$\Rightarrow 840 = \frac{ut}{\sqrt{2}} - 5t^2;$$

Substituting $\frac{ut}{\sqrt{2}}$ from equation (1)

$$840 = 1000 - 5t^2, 5t^2 = 160 \Rightarrow t = 4\sqrt{2} \text{ s}$$

substituting value of 't' in equation (1)

$$\text{we get } u \times 4\sqrt{2} = \sqrt{2} \times 1000$$

$$\Rightarrow u = 250 \text{ ms}^{-1}$$

10. A bullet is fired from the gun held horizontally such that the velocity of the bullet is 200 ms^{-1} and the gun is held 5 m above the ground. Find the horizontal distance covered by the bullet on reaching the ground. (Take $g = 10 \text{ ms}^{-2}$)

Solution: Given, initial horizontal velocity, $u = 200 \text{ ms}^{-1}$.

The vertical height, $y = 5 \text{ m}$.

Let the time taken to cover 5 m, = $t \text{ s}$.

$$g = 10 \text{ ms}^{-2}$$

$$\therefore y = \frac{1}{2}gt^2$$

$$\Rightarrow t^2 = \frac{2y}{g} = \frac{2 \times 5}{10} = 1$$

$$t = 1 \text{ s}$$

\therefore The horizontal distance covered in 1 s,

$$x = u t = 200 \times 1 = 200 \text{ m}$$

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. What would be the path of a body dropped from an aeroplane moving horizontally with reference to an observer sitting in the plane?
 - (1) Parabolic
 - (2) Vertically downward
 - (3) Horizontally
 - (4) Elliptical
2. An automobile travelling with a speed of 72 km h^{-1} , can be stopped within a distance of 20 m, by applying brakes.
 - (A) Determine the retardation.
 - (1) 100 ms^{-2}
 - (2) -10 ms^{-2}
 - (3) 5 ms^{-2}
 - (4) -5 ms^{-2}
 - (B) Determine the distance travelled in the first second.
 - (1) 10 m
 - (2) 15 m
 - (3) 25 m
 - (4) 35 m
3. The length of a minutes hand of a clock is 4 cm. The average velocity of the tip of the minutes hand when it moves during a time interval from 3 pm to 3.45 p.m. is _____ ms^{-1} .
 - (1) 2.2×10^{-3}
 - (2) 210
 - (3) 2.1×10^{-5}
 - (4) 3.2×10^{-2}
4. An automobile travelling with a speed of 72 km h^{-1} , can be stopped within a distance of 30 m, by applying brakes. What will be the stopping distance, if the automobile speed is increased to $\sqrt{3}$ times and the same breaking force is applied?
 - (1) 30 m
 - (2) 90 m'
 - (3) 60 m
 - (4) 120 m
5. A body when dropped from certain height falls to the ground in 4 s. What is the time taken by the body to cover the last 100 cm? (Take $g = 10 \text{ ms}^{-2}$)
 - (1) 0.65 s
 - (2) 0.15 s
 - (3) 0.125 s
 - (4) 0.025 s
6. A body is projected from the ground with a velocity of 30 ms^{-1} , making an angle of 30° with the horizontal. Find the maximum height obtained by it. (Take $g = 10 \text{ ms}^{-2}$).
 - (1) 32.5 m
 - (2) 62.5 m
 - (3) 11.25 m
 - (4) 12.55 m
7. Two bodies are projected horizontally from the top of a tower of height 20 m with velocities 30 ms^{-1} and 60 ms^{-1} . The ratio of time taken by them to reach the ground is _____.
 - (1) 1 : 2
 - (2) 2 : 1
 - (3) 1 : 1
 - (4) 3 : 2
8. A stone is thrown horizontally from the top of a tower with a velocity of 12 ms^{-1} . If it reaches the ground in 2 s, find the horizontal distance covered and the height of the tower.
 - (1) 24 m, 20 m
 - (2) 20 m, 24 m
 - (3) 12 m, 24 m
 - (4) 36 m, 20 m
9. A stone thrown vertically upward passes a certain point P at the end of 2 seconds and 8 seconds respectively. Find the maximum height reached by the stone. (Take $g = 10 \text{ ms}^{-2}$).
 - (1) 625 m
 - (2) 125 m
 - (3) 225 m
 - (4) 350 m
10. A stone is released from a hot-air balloon which is rising steadily with a velocity of 4 ms^{-1} . The velocity of the stone at the end of 3 s after it is released is _____ ms^{-1} .
 - (1) 29.4
 - (2) 25.4
 - (3) 32.5
 - (4) 62.7
11. A ball is thrown vertically upwards from the top of a tower with a velocity 10 ms^{-1} . The ball reaches the ground with a velocity 30 ms^{-1} . What is the height of the tower? (Take $g = 10 \text{ ms}^{-2}$)
 - (1) 40 m
 - (2) 20 m
 - (3) 60 m
 - (4) 80 m
12. A stone projected vertically upwards reaches to the level of a window 10 m from the ground. Find the magnitude of velocity of the stone at the time of its projection.
 - (1) 7 ms^{-1}
 - (2) 36 ms^{-1}
 - (3) 28 ms^{-1}
 - (4) 14 ms^{-1}
13. The time of ascent of a body projected with a velocity $u \text{ ms}^{-1}$ is _____.
 - (1) g/u
 - (2) $u^2/2g$
 - (3) u/g
 - (4) $2u/g$

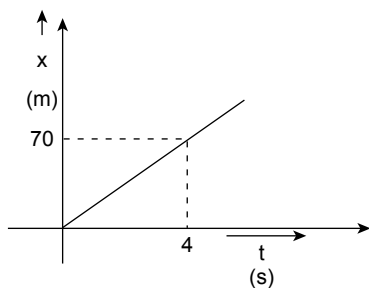
14. The ratio of magnitude of velocity of projection in the upward direction to the magnitude of velocity of the body on reaching the point of projection on its downward motion is _____.
 (1) 9 : 1 (2) 1 : 1
 (3) 2 : 1 (4) 4 : 1
15. When a body is projected upward it moves with a _____.
 (1) uniform velocity
 (2) uniform acceleration
 (3) uniform speed
 (4) Both (1) and (3)
16. What is the velocity of a vertically projected body at its maximum height (h)?
 (1) $\sqrt{2gh}$ (2) zero
 (3) $\frac{h^2}{g}$ (4) $\sqrt{\frac{2h}{g}}$
17. A hollow iron ball (A) and a solid iron ball (B) and cricket ball (C) are dropped from the same height. Which among the three balls reaches the ground first?
 (1) A
 (2) B
 (3) C
 (4) All the three balls will reach the ground simultaneously.
18. The speed of a body projected upwards _____.
 (1) decreases
 (2) increases
 (3) remains same
 (4) first decreases then increases
19. A body 'A' is dropped from a height h and the another body B is thrown horizontally with a velocity of 10 ms^{-1} from the same height simultaneously. If the time taken by the body A to reach the ground is 3 s, the time taken by the body B to reach the ground is _____.
 (1) 3 (2) 25
 (3) 75 (4) 5
20. A stone dropped from the top of a building takes 5 s to reach the ground. If it is stopped momentarily 4 s after it is dropped and then released again, how much time would it take from the moment it is released again to reach the ground?
 (Take $g = 10 \text{ ms}^{-2}$)
 (1) 1 s (2) 3 s
 (3) 4 s (4) 5 s
21. The distance travelled by a body starting with a velocity of 20 ms^{-1} , and moving with an acceleration of 2 ms^{-2} , in the 8th second is _____ m.
 (1) 35 (2) 20
 (3) 120 (4) 10
22. The final velocity of a body starts from rest and moving with an acceleration 2 ms^{-2} and covering a distance of 10 m is _____ ms^{-1} .
 (1) $\sqrt{98}$ (2) $\sqrt{40}$
 (3) $\sqrt{20}$ (4) $\sqrt{12}$
23. The acceleration of a body initially moving with a velocity of 5 ms^{-1} , if it attains a velocity of 25 ms^{-1} in 5 s is _____ ms^{-2} .
 (1) 8 (2) 7
 (3) 4 (4) 3
24. The displacement of a body starts from rest, and moving with an acceleration of 1 ms^{-2} at the end of 5 s is _____ m.
 (1) 12.5 (2) 25
 (3) 7.5 (4) 15
25. A body starts moving with an initial velocity of 5 ms^{-1} and an acceleration of 1 ms^{-2} . The distance travelled by it in the 5th second is
 (1) 9.5 m (2) 22.5 m
 (3) 50 cm (4) 10 cm
26. A bus travels the first one-third distance at a speed of 10 km h^{-1} , the next one-third distance at a speed of 20 km h^{-1} and the next one-third distance at a speed of 30 km h^{-1} .
 The average speed of the bus is
 (1) 20 ms^{-1} (2) $\frac{50}{11} \text{ ms}^{-1}$
 (3) $\frac{180}{11} \text{ ms}^{-1}$ (4) 30 ms^{-1}
27. The ratio of the time taken by a body moving with uniform acceleration in reaching two points P and Q along a straight line path is 1 : 2. If the body starts from rest and moves linearly, the ratio of the distances of P and Q from the starting point is
 (1) 4 : 1 (2) 1 : 4
 (3) 2 : 3 (4) 3 : 1

28. A body starts from rest and moves with uniform acceleration for 3 s. It then decelerates uniformly for 2 s and stops. If the deceleration is 3 ms^{-2} , the maximum velocity of the body is _____ ms^{-1} .
- zero
 - 2
 - 6
 - Cannot be determined
29. An ant moves from one corner of a hall to the diagonally opposite corner. If the dimensions of the hall are $8 \text{ m} \times 6 \text{ m}$, the displacement of the ant is _____ m.
- 14
 - 10
 - 28
 - 2
30. A particle moves from P to Q with a uniform velocity v_1 and Q to P with a velocity v_2 . If it moves along a straight line between P and Q then its average velocity will be _____.
- $\frac{2v_1 v_2}{v_1 + v_2}$
 - $\frac{v_1 v_2}{2}$
 - $\frac{v_1 + v_2}{2}$
 - zero
31. When brakes are applied the velocity of a car changes from 30 ms^{-1} to 10 ms^{-1} in 5 s. The acceleration produced in it is _____ ms^{-2} .
- 4
 - 4
 - 20
 - 20
32. A body starts from rest and moves with uniform acceleration for 2 s. It then decelerates uniformly for 3 s and stops. If deceleration is 4 ms^{-2} , the acceleration of the body is _____ ms^{-2} .
- 10
 - 8.7
 - 4
 - 6
33. The ratio of the heights from which two bodies are dropped is 3 : 5 respectively. The ratio of their final velocities is
- $\sqrt{5} : \sqrt{3}$
 - $\sqrt{3} : \sqrt{5}$
 - 9 : 25
 - 5 : 3
34. If a body is projected vertically up from a point and it returns to the same point, its
- average speed is zero, but not average velocity.
 - Both average speed and average velocity are zero.
 - average velocity is zero but not average speed.
 - Both average speed and velocity depend upon the path.
35. If a ball thrown vertically up attains a maximum height of 80 m, its initial speed is ($g = 10 \text{ ms}^{-2}$)
- 40 ms^{-1}
 - 20 ms^{-1}
 - 50 ms^{-1}
 - 10 ms^{-1}
36. A vertically projected body travels with
- uniform velocity.
 - uniform speed.
 - uniform acceleration.
 - uniform retardation.
37. A particle revolves along a circle with a uniform speed. The motion of the particle is _____.
- one dimensional
 - two dimensional
 - translatory
 - oscillatory
38. A body is projected horizontally from a certain height, (h) then time of descent is
- $t_d = \sqrt{\frac{2h}{g}}$
 - $t_d = \sqrt{\frac{h}{g}}$
 - $t_d = \sqrt{hg}$
 - $t_d = \sqrt{h+g}$
39. If u is the initial velocity, of a body projected with an angle θ with the horizontal, then the maximum height reached is _____.
- $\frac{u^2}{g}$
 - $\frac{u^2 \sin \theta}{2g}$
 - $\frac{u \sin \theta}{2g}$
 - $\frac{u^2 \sin^2 \theta}{2g}$
40. If the initial velocity of a body has both horizontal and vertical components and it is projected up with certain angle, then what is the path followed by it?
- Linear path
 - Elliptical path
 - Parabolic path
 - Spherical path

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 50: Select the correct alternative from the given choices.

- Find the initial velocity of projection of a ball thrown vertically up if the distance moved by it in 3rd second is twice the distance covered by it in 5th second. (Take $g = 10 \text{ ms}^{-2}$)
 (1) 45 ms^{-1} (2) 65 ms^{-1}
 (3) 20 ms^{-1} (4) 85 ms^{-1}
- A stone dropped from the top of a building takes 5 seconds to reach the ground. If it is stopped momentarily 3 s after it is dropped and then released again, the average velocity of the body is _____ ms^{-1} (take $g = 10 \text{ ms}^{-2}$)
 (1) 25 (2) 41.66
 (3) 62.5 (4) 17.85
- A body when projected at an angle 60° with the horizontal covers a horizontal distance of 90 m in 5 s. Instead, if the body is thrown upward with the same velocity. The maximum height attained by it is _____ m. (Take $g = 10 \text{ ms}^{-2}$)
 (1) 68.8 (2) 64.8
 (3) 34.8 (4) 36.4
- For a projectile, an of the horizontal distance covered by it is maximum when the angle of projection is _____.
 (1) 90° (2) 45°
 (3) zero (4) 30°
- The variation of horizontal displacement (x) of a projectile with time (t) is as shown in the figure. If the angle of projection is 60° , find the velocity of projection is ____ ms^{-1} .



- (1) 35 (2) 65
- (3) 30 (4) 50

- Two bodies are projected from the ground with the same speed. If the angles of their projection from the ground are 30° and 60° respectively, what is the ratio of their horizontal displacements after 2 s?
 (1) $1 : \sqrt{2}$ (2) $\sqrt{3} : 1$
 (3) $1 : \sqrt{3}$ (4) $\sqrt{2} : 1$
- A football is kicked from the ground in air such that it covers a maximum horizontal distance of 44 m. What is the maximum height attained by it? (Take $g = 10 \text{ ms}^{-2}$)
 (1) 11 m (2) 22 m
 (3) 44 m (4) 88 m
- A stone thrown from the ground just crosses a wall of height 5 m in 2 s. If the wall is at a horizontal distance 25 m, from the point of projection of the stone, find at what distance the stone falls behind the wall. ($g = 10 \text{ ms}^{-2}$).
 (1) 31.25 m (2) 6.25 m
 (3) 25 m (4) 32.5 m
- Two bodies of different masses m_1 and m_2 are dropped from two different heights h_1 and h_2 . What is the ratio of the times taken by the two to reach the ground?
 (1) $\sqrt{h_1} : \sqrt{h_2}$ (2) $\sqrt{h_2} : \sqrt{h_1}$
 (3) $m_1 h_2 : m_2 h_1$ (4) $m_1 h_1 : m_2 h_2$
- A particle is projected up with a velocity of $\sqrt{29} \text{ m s}^{-1}$ from the tower of height 10 m. What is its velocity on reaching the ground?
 (1) 25 ms^{-1} (2) 15 ms^{-1}
 (3) 12.5 ms^{-1} (4) 7.5 ms^{-1}
- A cannon elevated at an angle of 15° , throws a shell with a muzzle speed of 196 ms^{-1} . Due to air resistance the range decreases by 100 m, then what is the observed range?
 (1) 1960 m (2) 1860 m
 (3) 2000 m (4) 1660 m
- A person travels two parts of the total distance in the ratio 2 : 1 with constant speeds of 30 km h^{-1} and 40 km h^{-1} respectively. The average speed of the journey is _____ km h^{-1} .
 (1) 13.5 m (2) 62.2
 (3) 42.5 (4) 32.7

13. A person starts from point A and walks 120 m in north east direction, 120 m in south east direction, 120 m in north west direction and finally he is taken vertically upwards by a distance of 50 m with the help of a parachute. Find his total displacement from A.

(1) 130 m (2) 250 m
(3) 350 m (4) 670 m

14. Two bodies are projected from the ground with the same speed. If the angles of their projection from the ground are 45° and 15° respectively, the ratio of their range is

(1) 1 : 2 (2) 2 : 1
(3) $\sqrt{3} : 2$ (4) $1 : \sqrt{2}$

15. Two balls are projected horizontally from the top of a building simultaneously with velocities 15 ms^{-1} and 20 ms^{-1} respectively. The ratio of times taken by them to reach the ground is _____.

(1) 2 : 3 (2) 3 : 4
(3) 1 : 1 (4) 4 : 9

16. A freely falling body crosses points P, Q and R with velocities V , $2V$ and $3V$ respectively. Find the ratio of the distances PQ to QR.

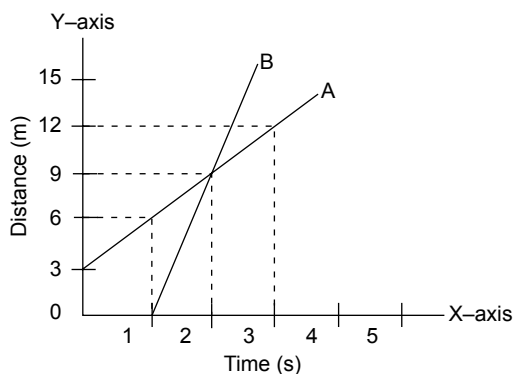
(1) 5 : 3 (2) 3 : 5
(3) 1 : 2 (4) 2 : 1

17. A bike moving along a straight road covers 35 m in the 4th second and 40 m in the 5th second. What is its initial velocity and acceleration (if the acceleration is assumed to be uniform)?

(1) 17.5 ms^{-1} (2) 8 ms^{-1}
(3) 7.8 ms^{-1} (4) 38.5 ms^{-1}

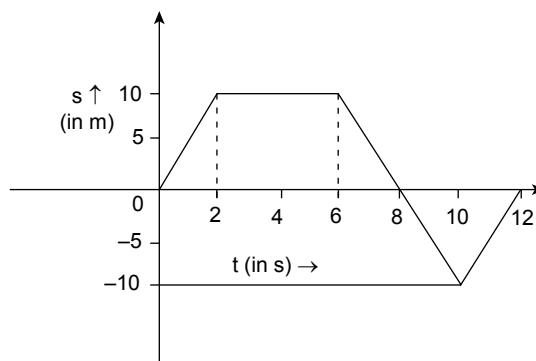
18. The adjacent figure shows the distance-time graph of two bodies A and B.

What is the distance travelled by A and B at the end of 2 s?



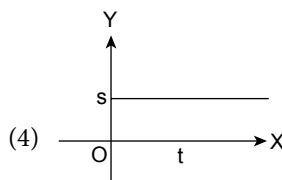
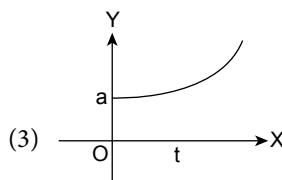
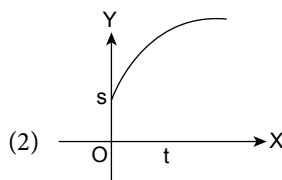
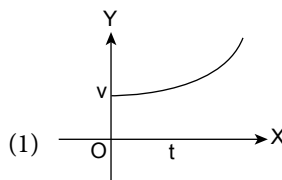
(1) 3 m, 6 m (2) 6 m, 9 m
(3) 9 m, 6 m (4) 3 m, 6 m

19. From the adjacent figure a displacement-time graph of a body moving in a straight line. Find the distance covered and the displacement of the body at the end of 12 seconds.

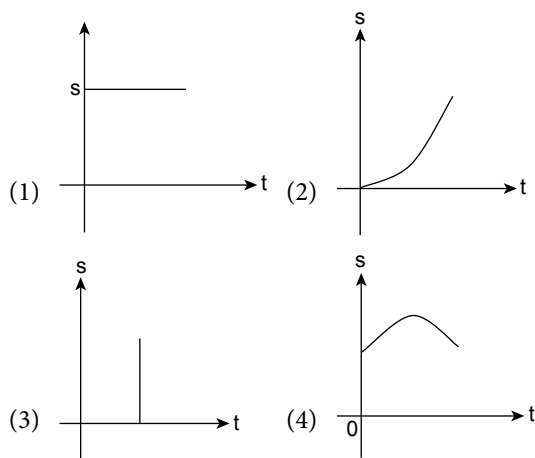


(1) 40 m, zero
(2) 20 m, zero
(3) 10 m, 10 m
(4) 20 m, 20 m

20. Which of the following graphs indicates that a body is undergoing retardation?



21. Which of the following graphs given below is impossible?



22. A car moves with a constant velocity of 10 ms^{-1} for 10 s along a straight road. Then it moves with uniform acceleration of 2 ms^{-2} for 5 seconds. Find the total displacement at the end of the 15 s of its motion.
- (1) 175 m (2) 125 m
(3) 150 m (4) 105 m
23. A person travels 6 m towards east and 8 m towards north from there again he travelled 16 m towards south. What is the displacement covered by the person?
- (1) 10 m (2) 20 m
(3) 30 m (4) 40 m
24. The velocity of a retarding body changes from 90 km h^{-1} to 36 km h^{-1} . Find its change in velocity in ms^{-1} .
- (1) -20 ms^{-1} (2) -15 ms^{-1}
(3) -18 ms^{-1} (4) -36 ms^{-1}
25. A person is running along a circular track of area $625 \pi \text{ m}^2$ with a constant speed. Find the distance travelled and displacement in 30 s and 15 s, if he has to complete the race in 30 s.
- (1) $200 \pi \text{ m}$ (2) $100 \pi \text{ m}$
(3) $25 \pi \text{ m}$ (4) $50 \pi \text{ m}$
26. An object travels for 10 s with uniform acceleration along a straight line path. During this period if the velocity of the object is increased from 5 ms^{-1} to 25 ms^{-1} , then find the distance travelled by the body.
- (1) 150 m (2) 100 m
(3) 125 m (4) 175 m
27. A pendulum of 28 cm length oscillates such that its string makes an angle of 30° with the vertical when

it is at one of the extreme positions. Find the ratio of the distance to displacement of the bob of the pendulum when it moves from one extreme position to the other.

- (1) 22 : 21 (2) 42 : 21
(3) 1 : 1 (4) 43 : 22
28. A train leaves station 'A' for station 'B'. The train travels along a straight line without any halts between the stations. During the first and last 200 m of its journey, the train has uniform acceleration and retardation both equal to 1 ms^{-2} respectively. For the rest of the journey, the train maintains uniform speed. Calculate the average speed of the train, given the distance between the two stations is 4 km.
- (1) $18 \frac{2}{11} \text{ ms}^{-1}$ (2) $9 \frac{2}{5} \text{ ms}^{-1}$
(3) $\frac{100}{11} \text{ ms}^{-1}$ (4) $17 \frac{6}{5} \text{ ms}^{-1}$
29. A body falls from a height of 45 m above the ground. Find the time taken by the body to reach the ground. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 5 s (2) 2 s
(3) 3 s (4) 6 s
30. A ball thrown vertically upwards with speed 'u' from the top of a tower reaches the ground in 9 s. Another ball thrown vertically downwards from the same position with speed 'u', takes 4 s to reach ground. Calculate the value of 'u'. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 15 ms^{-1} (2) 20 ms^{-1}
(3) 25 ms^{-1} (4) 45 ms^{-1}
31. A body is dropped from a certain height 'h' metres. Assuming that the gravitational field is nullified, after the body has travelled $h/2$ metres such that $g = 0$, discuss the motion of the body. Find an expression for the time taken by the body to reach the ground.
- (1) $\frac{3}{2} \sqrt{\frac{h}{g}}$ (2) $\sqrt{\frac{g}{h}}$
(3) \sqrt{gh} (4) $\frac{1}{2} \sqrt{2gh}$
32. A ball thrown vertically upwards with speed 'u' from the top of a tower reaches the ground in 9 s. Another ball thrown vertically downwards from the same position with speed 'u', takes 4 s to reach ground. Calculate the value of 'u'. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 125 ms^{-1} (2) 75 ms^{-1}
(3) 25 ms^{-1} (4) 175 ms^{-1}

33. An object projected vertically up from the top of a tower took 5 s to reach the ground. If the average velocity of the object is 5 ms^{-1} , find its average speed. (given $g = 10 \text{ ms}^{-2}$).
- (1) 65 ms^{-1} (2) 13 ms^{-1}
 (3) 26 ms^{-1} (4) 25 ms^{-1}
34. Two stones A and B are dropped from the top of two different towers such that they travel 44.1 m and 63.7 m in the last second of their motion respectively. Find the ratio of the heights of the two towers from where the stones were dropped.
- (1) 16 : 25 (2) 7 : 9
 (3) 5 : 7 (4) 25 : 49
35. A ball which is thrown vertically up from the top of a tower reaches the ground in 12 s. Another ball thrown vertically downwards from the same position with same velocity takes 4 s to reach the ground. Find the height of the tower. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 180 m (2) 120 m
 (3) 220 m (4) 240 m
36. A body is dropped from a height of 2 m. It penetrates into the sand on the ground through a distance of 10 cm before coming to rest. What is the retardation of the body in the sand?
- (1) -9.8 ms^{-2} (2) 196 ms^{-2}
 (3) -196 ms^{-2} (4) 9.8 ms^{-2}
37. A ball is thrown vertically upwards with an initial velocity such that it can reach a maximum height of 15 m. If, at the same instance, a stone is dropped from a height of 15 m, find the ratio of distances travelled by them when they cross each other.
- (1) 4 : 3 (2) 2 : 3
 (3) 1 : 2 (4) 3 : 1
38. A balloon starts rising from the ground, vertically upwards, uniformly at the rate of 1 ms^{-1} . At the end of 4 seconds a body was released from the balloon. Calculate the time taken by the released body to reach the ground. Take $g = 10 \text{ ms}^{-2}$.
- (1) 4 s (2) 1 s
 (3) 6 s (4) 3 s
39. A body is projected from the ground with a velocity of 10 ms^{-1} such that it makes an angle 30° with the horizontal. What is the horizontal velocity at the maximum height?
- (1) $6\sqrt{2} \text{ m s}^{-1}$ (2) $9\sqrt{2} \text{ ms}^{-1}$
 (3) $3\sqrt{5} \text{ ms}^{-1}$ (4) $5\sqrt{3} \text{ ms}^{-1}$
40. A body is projected horizontally with a velocity $\sqrt{23} \text{ ms}^{-1}$ from a height of 5 m. What is the velocity of the body on reaching the ground?
- (1) 22 ms^{-1} (2) 11 ms^{-1}
 (3) 62 ms^{-1} (4) 12 ms^{-1}

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

1. 2	2. (A) 2	(B) 2	3. 3	4. 2	5. 4	6. 3	7. 3	8. 1	9. 2
10. 2	11. 1	12. 4	13. 3	14. 2	15. 3	16. 2	17. 3	18. 4	19. 1
20. 2	21. 1	22. 2	23. 3	24. 1	25. 1	26. 2	27. 2	28. 3	29. 2
30. 4	31. 2	32. 4	33. 2	34. 3	35. 1	36. 3	37. 2	38. 1	39. 4
40. 3									

PRACTICE EXERCISE 2 (B)

1. 2	2. 4	3. 2	4. 2	5. 1	6. 2	7. 1	8. 2	9. 1	10. 2
11. 2	12. 4	13. 1	14. 2	15. 3	16. 2	17. 1	18. 2	19. 1	20. 2
21. 3	22. 1	23. 1	24. 2	25. 4	26. 1	27. 1	28. 1	29. 3	30. 3
31. 1	32. 3	33. 2	34. 4	35. 4	36. 2	37. 4	38. 2	39. 4	40. 2

Dynamics

SYNOPSIS

- Momentum (p) = mass (m) \times velocity (v)
- Newton's first law of motion states that 'every body remains in the state of rest or of uniform motion along a straight line unless it is acted upon by an external force'.
- Inertia is the property of an object which resists the change in its state of rest or that of uniform motion.
- Newton's second law of motion states that 'rate of change of linear momentum is directly proportional to the resultant force acting on the body and takes place in the direction of the force'.
Force (F) = mass (m) \times acceleration (a)
- Newton's third law of motion states that 'for every action there is an equal and opposite reaction'.
- Work (w) = force (\vec{F}) \times displacement (\vec{S}) = $F s \cos\theta$, where θ is the angle between the direction of applied force (F) and the direction of its displacement (s).
- Energy is the ability to do work. Unit of energy is the same as that of work.
- Potential energy is the energy possessed by a body by virtue of its position. Potential energy of a body of mass ' m ' at a height ' h ' from the ground is $P.E = mgh$ where ' g ' is acceleration due to gravity.
- Kinetic energy is the energy possessed by a moving body. Kinetic energy (K.E.) of a body of mass ' m ' moving with velocity ' v ' is $K.E. = \frac{1}{2} mv^2$
- The total work done on a body by all the external forces is equal to the change in kinetic energy.
- Power = $\frac{\text{work}}{\text{time}}$ It is measured in watt.
- Law of conservation of energy states that 'energy can neither be created nor be destroyed but it can be transformed from one form to another'.
- Two equal and unlike parallel forces constitute a couple. A couple does not produce translatory motion. Rotating effect of the couple is known as moment of couple.
- Centre of gravity (C.G.) is a point where the whole weight of the body is assumed to be acting.
- Mechanical advantage (M.A.) = $\frac{\text{load}(w)}{\text{effort}(E)}$.
- Velocity ratio (V.R.) = $\frac{\text{velocity of the effort}}{\text{velocity of the load}}$
= $\frac{\text{displacement of the effort}}{\text{displacement of the load}}$
- Efficiency ' η ' = $\frac{\text{work done by the machine}}{\text{work done on the machine}} = \frac{\text{output}}{\text{input}}$
$$\eta = \frac{\text{mechanical advantage(M.A.)}}{\text{velocity ratio(V.R.)}}$$

- Mechanical advantage of a lever = $\frac{\text{load}}{\text{effort}} = \frac{\text{effort arm}}{\text{load arm}}$.
- Mechanical advantage (M.A.) of wheel and axle system M.A. = $\frac{\text{radius of the wheel}}{\text{radius of the axle}}$
- M.A of screw jack = $\frac{2\pi L}{H}$
Where L is the length of the lever from the axis of the screw and H is the height through which the load is lifted.
- M.A. of an inclined plane = $\frac{\text{Length of the plane } (\ell)}{\text{height of the plane } (h)}$
- If a particle moves along a circle with uniform speed, then the motion of the particle is called as uniform circular motion.
- angular velocity (ω)
$$= \frac{\text{angular displacement } (\Delta\theta)}{\text{time}(\Delta t)} = \frac{\Delta\theta}{\Delta t}$$
- Linear velocity (v) = angular velocity (ω) \times radius of circular path (r).
$$v = \omega \times r$$
- Angular momentum (L) = $mvr = mr^2\omega$.
- Time taken to complete one revolution is called period (T).
$$T = \frac{2\pi}{\text{angular velocity}} = \frac{2\pi}{\omega}$$
- The banking angle $\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$ Where 'v' is the velocity of the vehicle, 'r' is the radius of curvature of the road and 'g' is acceleration due to gravity.
- (i) Kepler's first law states that all planets revolve around the sun in elliptical orbits of different radii with the sun at one of their foci points.
(ii) According to Kepler's second law, an imaginary line drawn from the sun to the planet sweeps out

equal areas in equal intervals of time, or areal velocity of planets is constant.

- (iii) Kepler's third law states that the square of the time period (T) of a planet is proportional to the cube of the semi-major axis (d). $T^2 \propto d^3$
- Newton's universal law of gravitation states that every body in the universe attracts every other body with a force (F) which is directly proportional to the product of their masses and inversely proportional to the square of the distance (d) between them.
$$F \propto \frac{m_1 m_2}{d^2}, F = G \frac{m_1 m_2}{d^2}, G \text{ is the universal gravitational constant.}$$
- The acceleration due to gravity on the surface of any planet of mass M and radius R is $g = \frac{GM}{R^2}$.
'g' at a height 'h' from the surface of planet
$$g_h = \frac{GM}{(R+h)^2} g_h = g \left(1 - \frac{2h}{R}\right) \text{ when } h < R$$

variation of g with respect to depth 'd' is given by
$$g_d = g \left(1 - \frac{d}{R}\right).$$
- At the centre of planet $g_d = 0$.
- The horizontal velocity with which a satellite revolves around the planet is called as orbital velocity (V_o).
$$V_o = \sqrt{\frac{GM}{R+h}}$$

Where R is the radius of the planet, M is the mass of the planet and 'h' is the height of the satellite from the surface of the planet.
- Escape velocity (v_e) is the minimum velocity required for any body to escape from the earth's gravitation pull.
$$V_e = \sqrt{\frac{2GM}{R}}; V_e = \sqrt{2} \times V_o$$

 \therefore The orbital velocity of a satellite very close to the surface of the earth is $V_o = \sqrt{\frac{GM}{R}}$.

Solved Examples

1. A car of mass 1000 kg moves uniformly at 10 ms^{-1} . If the engine of the car develops an extra linear momentum of 1000 kg ms^{-1} , calculate the new velocity with which the car runs.

Solution: Initial momentum of the car $P_1 = m \times v_1$
 $P_1 = 1000 \times 10$; $P_1 = 10,000 \text{ N s or kg ms}^{-1}$
Increase in momentum of the car = 1000 N s

Thus new momentum of the car

$$P_2 = P_1 + \text{increase in momentum}$$

$$P_2 = 10,000 + 1000; P_2 = 11000 \text{ Ns}$$

$$P_2 = m \times v_2 \text{ Where } v_2 \text{ is the new velocity of the car}$$

$$\therefore 11000 = 1000 \times v_2$$

$$\Rightarrow v_2 = \frac{11000}{1000} = 11 \text{ m s}^{-1}; v_2 = 11 \text{ ms}^{-1}$$

2. A force of 500 N acts on a body of mass 1000 kg and the body is brought to rest within a distance of 64 m. Find the initial velocity and the time taken by the body to come to rest.

Solution: Force, $F = 500 \text{ N}$; Mass of the body, $m = 1000 \text{ kg}$

From Newton's second law of motion,

$F = ma$, where F , m and a are the force, mass and acceleration respectively.

$$\therefore a = \frac{F}{m} = \frac{500}{1000} = 0.5 \text{ ms}^{-2}$$

To find initial velocity, consider the equation of motion $v^2 = u^2 + 2as$

Since the body is retarding $a = -0.5 \text{ ms}^{-2}$ and since it comes to rest $v = 0$

$$\therefore 0 = u^2 + (2 \times (-0.5) \times 64)$$

$$0 = u^2 - (1 \times 64) \Rightarrow u^2 = 64$$

$$\Rightarrow u = \sqrt{64} = 8 \text{ ms}^{-1}$$

To find the time taken, consider the equation of motion $v = u + at$

$$0 = 8 - 0.5 \times t \Rightarrow t = \frac{8}{0.5} = 16 \text{ s}$$

$$\therefore u = 8 \text{ ms}^{-1}, t = 16 \text{ s and } a = -0.5 \text{ ms}^{-2}$$

3. A ball of mass 50 g at rest is hit by a bat and the ball covers 400 m in 2 s. If the ball was in contact with the bat for 0.1 s , find the magnitude of force applied on it. Assume that no other force acts on the ball after it is hit by the bat.

Solution: We are given that the distance covered by ball is 400 m. $\therefore s = 400 \text{ m}$

Time in which the ball covers a distance of 400 m = 2 s

$$\therefore \text{Final velocity of the ball} = \frac{400}{2} = 200 \text{ ms}^{-1}$$

This is the velocity of the ball after being hit.

Initial velocity of the ball i.e., the velocity of the ball before being hit by the bat = 0

Time for which the force acts = 0.1 s

From equation of motion

$$v = u + at \Rightarrow 200 = 0 + a \times 0.1$$

$$\Rightarrow a = \frac{200}{0.1} = 2000 \text{ ms}^{-2}$$

From Newton's second law $F = ma$.

Mass of the ball $m = 50 \times 10^{-3} \text{ kg}$.

$$\Rightarrow F = 50 \times 10^{-3} \times 2000 = 100 \text{ N}$$

Force acting on the ball = 100 N.

4. An object is suspended from the ceiling of a lift by means of a string. When the lift starts moving in the upward direction the string breaks and the object falls into the lift. Explain giving reasons.

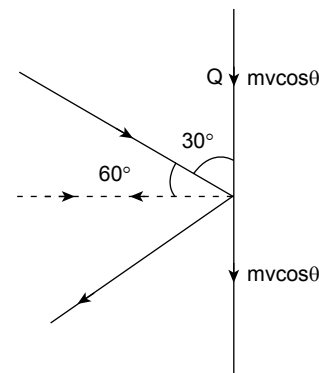
Solution: When the lift is in the state of rest the weight of the object is balanced by the tension of the string. When it starts moving in the upward direction the total force acting on the object in the downward direction increases. This is similar to a person sitting in a vehicle being pushed backwards when the vehicle accelerates forward. The string breaks if the total force acting on the object exceeds its maximum tensile strength.

5. A ball of mass 500 g hits a wall with a velocity 10 ms^{-1} such that it makes an angle 60° with the normal. It bounces back with the same speed making an angle of 60° with the normal. Determine the change in momentum.

Solution: The vertical component of the momentum = $mv \cos \theta = mv \cos 30^\circ$

Change in vertical component of P .

$$P_2 - P_1 = mv \cos 30^\circ - mv \cos 30^\circ = 0$$



Horizontal component of the momentum

$$p = mv \sin 30^\circ$$

$$= 0.5 \times 10 \times \frac{1}{2} = 2.5 \text{ kg ms}^{-1}$$

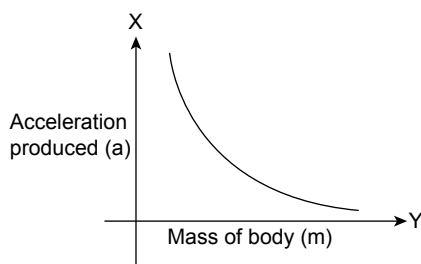
$$p_1 = +2.5 \text{ kg ms}^{-1}; p_2 = -2.5 \text{ kg ms}^{-1}$$

$$p_2 - p_1 = -2.5 - (+2.5) = -5 \text{ kg ms}^{-1}$$

6. What is the nature of a graph drawn between mass and acceleration for a constant force? Does the graph pass through origin?

☞ **Solution:** The graph between mass of a body and acceleration produced in it, for a constant force is as shown above.

The graph does not pass through the origin.



7. What is the work done by a force of 2 N in displacing a body by 2 m in the direction of the force?

☞ **Solution:** Work done = $\vec{F} \cdot \vec{s} = Fs \cos \theta$

F is the force, s is the displacement and θ is the angle between F and s.

In the given example, $\theta = 0^\circ$, $F = 2 \text{ N}$, $s = 2 \text{ m}$

$$\Rightarrow \text{Work done} = 2 \times 2 \times \cos 0^\circ = 2 \times 2 \times 1 = 4 \text{ J}$$

8. What is the work done by a porter in carrying a load of 50 kg

- while walking along the platform, and
- while climbing up a slope of height 10 m ($g = 10 \text{ ms}^{-2}$)?

☞ **Solution:** While carrying a load the porter applies a force equal to mg vertically upwards.

- (i) Work done by a porter along the horizontal

$$W = \vec{F} \cdot \vec{s} = Fs \cos \theta$$

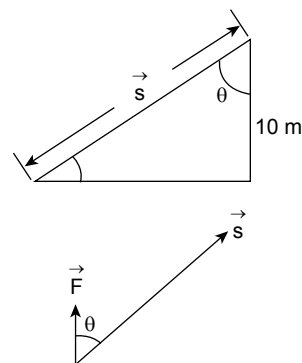
F is the force, s is displacement and θ is angle between F and s

Since $\theta = 90^\circ$

$$\text{Work done } W = F \cdot s \cos 90^\circ = 0 \text{ (zero)}$$

\therefore Work done when the porter walks along the platform = 0.

- (ii) Work done when the porter walks along the slope



$$W = \vec{F} \cdot \vec{s} = Fs \cos \theta$$

Work is done against the force of gravity

$$F = mg \text{ and } s \cos \theta = h [\because \cos \theta = \cos 0 = 1]$$

$$\therefore W = mgh$$

$$\therefore W = 50 \times 10 \times 10 = 5000 \text{ joules} = 5 \text{ kJ}$$

9. In a hydroelectric power station water is allowed to fall at the rate of 2000 kg per second on a turbine kept 100 m below the water level.

- Calculate the potential energy of water falling every one second at the highest point.
- Find kinetic energy of this water when it falls through a height of 25 m.
- If 80% of initial potential energy is converted into electrical energy, calculate the power output in 1 second ($g = 10 \text{ ms}^{-2}$).

☞ **Solution:** (i) From definition of potential energy (P.E)

$$PE = mgh = 2000 \times 10 \times 100 = 2 \times 10^6 \text{ J.}$$

From law of conservation of energy, total energy at the highest point

$$E_1 = \text{potential energy} + \text{kinetic energy}$$

$$E_1 = mgh + 0 \text{ (KE at the highest point = 0)}$$

$$\Rightarrow E_1 = 2 \times 10^6 \text{ J}$$

- (ii) When water falls through a height of 25 m its potential energy decreases but the kinetic energy (K.E.) increases.

$$\text{Total energy} = P.E + K.E$$

$$E_1 = mgh_1 + K.E \text{ where } h_1 = 100 - 25 = 75 \text{ m (height from the ground level)}$$

$$\begin{aligned}
 \therefore P_1 &= P.E \text{ at } h_1 = mgh_1 \\
 &= 2000 \times 10 \times 75 \\
 &= 150 \times 10^4 = 15 \times 10^5 \text{ J} \\
 &= 1.5 \times 10^6 \text{ J}
 \end{aligned}$$

From law of conservation of energy, total energy remains constant.

$$\begin{aligned}
 \therefore E_1 &= P_1 + K.E \\
 E_1 &= 2 \times 10^6 \text{ J}; \\
 P_1 &= 1.5 \times 10^6 \text{ J} \\
 2 \times 10^6 \text{ J} &= 1.5 \times 10^6 + K.E
 \end{aligned}$$

$$K.E = 2 \times 10^6 - 1.5 \times 10^6 = 0.5 \times 10^6 \text{ J}$$

(iii) 80% of initial potential energy is converted into electrical energy

$$80\% \text{ of } E_1 = \frac{80}{100} \times 2 \times 10^6$$

$= 16 \times 10^5 \text{ J}$ is converted into electrical energy

$$\begin{aligned}
 \text{Power output} &= \frac{\text{work}}{\text{time}} = \frac{\text{energy}}{\text{time}} \\
 &= \frac{16 \times 10^5}{1} = 16 \times 10^5 \text{ W}
 \end{aligned}$$

Thus the power output is $16 \times 10^5 \text{ W} = 1.6 \text{ MW}$

10. What kind of work is done on an object by the gravity when

- (a) an object is slid on a horizontal ground?
- (b) an object is slid up on an inclined plane?
- (c) an object is slid down on an inclined plane?

☞ **Solution:** (a) The work done by the gravity on an object sliding on a horizontal ground is zero.

(b) The work done by the gravity on an object sliding upwards is negative.

(c) The work done by the gravity on an object sliding downward is positive.

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 50: Select the correct alternative from the given choices.

1. Calculate the velocity of a body of a mass 2 kg whose linear momentum is 5 N s.

(1) 2.5 ms^{-1} (2) 10 ms^{-1}
(3) 5 ms^{-1} (4) 2 ms^{-1}

2. A body of mass 5 kg accelerates from rest to a velocity of 10 ms^{-1} in 5 s. Calculate the net force acting on the body.

(1) 25 N (2) 5 N
(3) 10 N (4) 250 N

3. A body of mass 1 kg moves with a velocity 5 ms^{-1} . A force is applied on it for 1 ms such that its velocity is increased to 7 ms^{-1} . The force applied on the body is _____ N.

(1) 2000 (2) 200
(3) 20 (4) 2

4. The linear momentum of a body can be changed by _____.

(1) any force (2) a net external force
(3) an internal force (4) Both (2) and (3)

5. 1 dyne force can produce an acceleration of _____ cm s^{-2} on an object of mass 100 g.

(1) 1 (2) 0.1
(3) 10 (4) 0.01

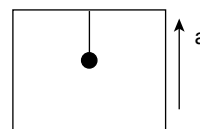
6. Action and reaction

(1) always act on two different bodies.
(2) are equal in magnitude.
(3) act in opposite directions.
(4) All the above

7. Determine the force acting on a body if the velocity of the body is changed from 5 ms^{-1} to 10 ms^{-1} in 2 s. The density and volume of the object are 5000 kg m^{-3} and 0.005 m^3 .

(1) 100 N (2) 65.5 N
(3) 32.5 N (4) 62.5 N

8. An object of mass M is hanging from the string as shown in the figure. If the uniform acceleration of the cabin in the upward direction is 'a', determine the tension in the string.



(1) $m(g - a)$ (2) ma
(3) mg (4) $m(g + a)$

9. A cricket ball of mass 300 g is bowled towards a batsman with a speed of 180 km h^{-1} . The batsman hits the ball such that it bounces back with the same speed. If the force exerted by the bat on the ball is 3000 N, find the duration of the impact is _____ s.

(1) 1 (2) 0.01
(3) 0.1 (4) 0.04

10. A bullet of mass 0.02 kg moving with a velocity of 30 ms^{-1} is brought to rest by a wooden plank. Calculate the work done on the bullet before it comes to rest.

(1) -9 (2) 9
(3) 18 (4) -18

11. Two bodies of masses m_1 and m_2 have equal kinetic energies. Find the ratio of their momenta.

(1) $\sqrt{\frac{m_1}{m_2}}$ (2) $\frac{m_1}{m_2}$
(3) $\sqrt{\frac{m_2}{m_1}}$ (4) $\sqrt{\frac{m_2}{m_1}}$

12. A body of mass 'm' is dropped from a height 'h'. The kinetic energy of the body on reaching the ground is _____.

(1) 4 mgh (2) 2 mgh
(3) mgh (4) 3 mgh

13. A force of 10 N is applied on an object at rest of mass 2 kg placed on a smooth surface. The kinetic energy of the body after 5 s is _____ J.

(1) 124.6 (2) 625.5
(3) 312.5 (4) 683.8

14. In the case of an oscillating simple pendulum, if the air resistance is taken into consideration, then _____.

(1) amplitude of oscillation remains the same
(2) frequency remains the same
(3) the resultant acceleration remains the same
(4) All the above

15. The momentum of a body is increased by 50%. If v_1 is the initial velocity of the body the change in kinetic energy is

(1) $2mv_1^2$ (2) $\frac{5}{4}mv_1^2$
 (3) $\frac{5}{8}mv_1^2$ (4) $\frac{3}{2}mv_1^2$

16. Work done on a body depends

- (1) only on the magnitude of external force applied on the body.
 (2) only on the displacement of the body.
 (3) on both the displacement of the body and the component of the external force acting in the direction of its displacement.
 (4) None of the above

17. A person walks 100 m, holding a suitcase of weight 100 N. The work done by the applied force is ____ J.

(1) 10000 (2) 100
 (3) zero (4) 5000

18. A person of mass 60 kg with a load of 20 kg on his head climbs up to a height of 10 m in 4 s. Calculate his power. Given $g = 10 \text{ ms}^{-2}$.

(1) 2000 W (2) 200 W
 (3) 4000 W (4) 8000 W

19. A body is projected vertically upwards from ground with a velocity 'u' and it gains a maximum height 'H'. At a point 'x' height ($x < H$), the ratio of its potential to kinetic energy is 1 : 2. Now if the body is projected upwards with a velocity '3u' from the ground, find the ratio of its potential to kinetic energy at a point whose height is '3x'.

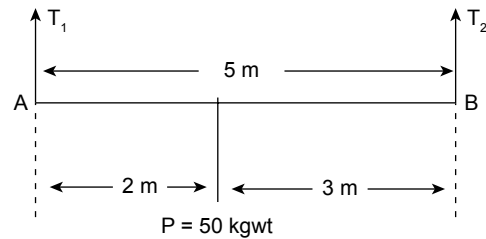
(1) 4 : 1 (2) 1 : 8
 (3) 18 : 1 (4) 16 : 1

20. A stone of mass 'm' falls from a height 'h' into sand pit and moves down into the sand through a distance 's' before it comes to the state of rest. Calculate the resistance force offered by the sand on the stone.

(1) $mg\left(1 + \frac{h}{s}\right)$ (2) $mg\frac{h}{s}$
 (3) $mg(s + h)$ (4) $mg\left(\frac{1-s}{h}\right)$

21. A painter of 50 kgwt stands on a wooden plank of length 5 m. The plank is suspended at its ends by ropes. The painter stands at a distance 2 m from one end of the plank. Find the tensions ____ T_1 and T_2

(force) on the support are ____ kgwt and ____ kgwt respectively.



(1) 30, 20 (2) 20, 30
 (3) 15, 30 (4) 50, 30

22. A person draws 10 kg water from a well at a depth of 5 m using a single fixed pulley by applying an effort of 120 N. Find the efficiency of the machine.

($g = 10 \text{ ms}^{-2}$)

(1) 83% (2) 16%
 (3) 66% (4) 33%

23. A load of 60 kg is lifted using a wheel and axle, the sum of whose diameters is 1.2 m, by a man and his son who can share their efforts in the ratio 2 : 1. If the radius of the axle is 10 cm, find the effort contributed by the son. ($g = 10 \text{ ms}^{-2}$).

(1) 120 N (2) 80 N
 (3) 40 N (4) 160 N

24. An object of mass 0.98 kg is lifted by applying an effort of 9.8 N on a single fixed pulley. The efficiency of the machine is ____%.

(1) 98 (2) 45
 (3) 100 (4) 49

25. A load of 80 kg is lifted using a wheel and axle, the sum of whose diameters is 2.4 m, by a man and his son who can share their efforts in the ratio 3 : 2. If the radius of the axle is 20 cm, find the effort contributed by the son. ($g = 10 \text{ ms}^{-2}$).

(1) 62 N (2) 32 N
 (3) 96 N (4) 64

26. ____ is applied to unwind a screw.

(1) single force (2) couple
 (3) like parallel force (4) None of these

27. A metre scale is suspended at 50 cm mark to a rigid support with a weight of 150 g attached at 5 cm mark. To balance the scale, a weight of 450 g should be attached at ____ cm mark.

(1) 65 (2) 90
 (3) 95 (4) 100

28. A pulley system has a single fixed pulley and a single movable pulley. Its mechanical advantage is _____.
 (1) 1 (2) 2
 (3) 3 (4) 4
29. A force of 10 N is applied at the farthest edge from the hinge of a door of width 50 cm such that the line of action of force makes angle of 90° with the normal to the surface of the door. Determine the moment of force of the door.
 (1) 5 Nm (2) 500 Nm
 (3) zero (4) 50 Nm
30. A metre scale 'PQ' of uniform thickness and weighing 100 gwt is suspended by means of a string to a rigid support at a point 'R' on it such that $PR : QR = 2 : 3$. At the end 'P' a load of 85 g_wt is attached. Find the load attached at Q such that the scale is in equilibrium. If 'S' is a point on the scale such that $PR : SR = 2 : 1$ and the load at 'Q' is shifted to 'S'; find the percentage change in the load, in shifting it from 'Q' and 'S'; to maintain equilibrium state of the scale.
 (1) 200% (2) 100%
 (3) 300% (4) 150%
31. A record player makes 60 rpm (revolution per minute). Its angular velocity and its period are _____ rad s^{-1} and _____ s respectively.
 (1) $2\pi, 1$ (2) $2\pi, 2$
 (3) $\pi, 2$ (4) $\pi, 1$
32. Work done by the centripetal force on a body of mass 'm' which is undergoing a uniform circular motion with a speed is _____.
 (1) mv (2) mv^2
 (3) zero (4) $\frac{mv^2}{2}$
33. Sugar crystals can be separated from molasses using a _____.
 (1) steel yard (2) centrifuge
 (3) wheel and axle (4) screw jack
34. An object placed on a rotating platform moves away from the centre due to _____.
 (1) centripetal force (2) centrifugal force
 (3) angular velocity (4) angular acceleration
35. A particle moves in a circle whose radius is 20 cm with a linear speed of 10 ms^{-1} . Then its angular velocity is _____ rad s^{-1} .
 (1) 100 (2) 50
 (3) 25 (4) 125
36. Two particles of equal mass are revolving with the same linear speed on circular paths of radii r_1 and r_2 . The ratio of their angular velocity is _____.
 (1) $\frac{r_2}{r_1}$ (2) $\sqrt{\frac{r_2}{r_1}}$
 (3) $\left(\frac{r_1}{r_2}\right)^2$ (4) $\left(\frac{r_2}{r_1}\right)^2$
37. The angular momentum of a particle of mass 2 kg moving along a circular path of radius 2 m with an angular velocity of 2 rad s^{-1} is _____ kg $\text{m}^2 \text{ rad s}^{-1}$.
 (1) 64 (2) 8
 (3) 32 (4) 16
38. Two bodies A and B having masses in the ratio 1 : 2 are in uniform circular motion along two concentric circular paths. The angular velocity of A is four times that of B. If the centripetal force on both of them are equal find the ratio of difference in the radii to the smaller radius.
 (1) 1 : 7 (2) 7 : 1
 (3) 8 : 1 (4) 81 : 4
39. A stone tied to a string 1 m long is whirled in a circular path in a vertical plane. If the difference in the tension on the string at the bottom and top is 120 N, determine the mass of the stone.
 (take $g = 10 \text{ ms}^{-2}$).
 (1) 5 kg (2) 1 kg
 (3) 2 kg (4) 12 kg
40. PSLV is
 (A) a rocket (B) a satellite
 (1) Only 'A' is true.
 (2) Only 'B' is true
 (3) Both 'A' and 'B' are true.
 (4) Both 'A' and 'B' are false.
41. Gravity meters measure in units of mGal where 1 Gal (or 1 galileo) is the C.G.S. unit of acceleration due to gravity. A gravity meter shows a reading of +300 mGal at a place where the normal 'g' is 9.78 ms^{-2} . The correct 'g' at that place where the reading was taken is _____ ms^{-2} .
 (1) 9.777 (2) 9.783
 (3) 9.750 (4) 9.810

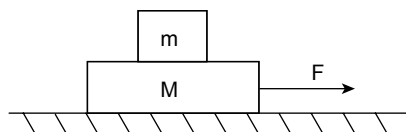
42. It is found that the speed of the earth around the sun increases when it is close to the sun.
- Angular velocity of the earth is constant
 - Areal velocity of the earth is not constant.
 - Areal velocity of the earth is constant.
 - None of these
43. An object is dropped on the surface of earth from a height of 3600 km. Calculate the ratio of the weight of the body at that height and on the surface of earth.
- 1.34
 - 2.44
 - 6.25
 - 12.32
44. The reading of a spring balance calibrated on the surface of the earth is taken to a planet where the value of g is 7 ms^{-2} is 10 kgwt. What is the mass of the object?
- 10 kg
 - 7 kg
 - 70 kg
 - 14 kg
45. The escape velocity on earth is 11.2 km s^{-1} . What is the escape velocity on a planet of radius four times the radius of earth and one fourth of the density of earth?
- 11.2 km s^{-1}
 - 22.4 km s^{-1}
 - 44.8 km s^{-1}
 - 26.2 km s^{-1}
46. Two satellites of equal masses are launched from two planets A and B of masses m and $3m$ respectively. If the kinetic energy of the satellites revolving around planet A is double that of the satellite revolving around planet B, determine the ratio of radii of the two orbits.
- 2 : 3
 - 3 : 4
 - 1 : 4
 - 4 : 3
47. The average radius of the orbit of the revolution of a planet around the sun is three times greater than that of the earth. How many years does the planet take to revolve once around the sun?
- 8
 - 1
 - 16
 - 2
48. A body moving with a kinetic energy of 20 J on a horizontal frictionless surface hits a spring whose one end is fixed to a rigid wall and it compresses the spring and comes to rest. What is the potential energy of the spring when it is compressed to the maximum?
- 10 J
 - 20 J
 - zero
 - 30 J
49. A vehicle can travel along a curved road with a speed of 18 km h^{-1} . If the total centripetal force is provided by the banking of the road and the radius of curvature is 10 m, calculate the banking angle of the road.
- 90°
 - 30°
 - 14°
 - 26°
50. The escape velocity on a planet is equal to the orbital velocity on another planet. If the radii of two planets are equal, determine the ratio of acceleration due to gravity on the two planets.
- 5 : 2
 - 3 : 4
 - 2 : 3
 - 1 : 2

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 50: Select the correct alternative from the given choices.

- A rubber ball of mass 250 g hits a wall normally with a velocity of 10 ms^{-1} and bounces back with a velocity of 8 ms^{-1} . The impulse is _____ Ns.
 - 0.5
 - + 0.5
 - 4.5
 - + 4.5
- Force required to produce an acceleration of 1 ms^{-2} on a body of mass 1 kg is _____ N.
 - 1
 - 2
 - 3
 - 4
- An object A of mass of 0.1 kg exerts a force of 1N on a body B. Then the acceleration of the body A is _____ ms^{-2} .
 - Zero
 - 10
 - 10
 - 5
- Which of the following laws of motion is (are) involved in the motion of the rocket?
 - Newton's first law of motion.
 - Newton's second law of motion.
 - Newton's third law of motion.
 - All the above

5. A smaller block of mass 'm' is placed on another block of mass M. When a horizontal force F is applied on the block of mass M as shown in the figure, the smaller block does not slide. If the magnitude of friction between the bigger block and the ground is 'f', determine the magnitude and direction of friction between the two blocks.



- (1) $\frac{F}{M+m}$ (2) $\frac{F-f}{M+m}$
 (3) $\frac{F+f}{M+m}$ (4) $\frac{F-f}{m}$
6. An object of mass m_1 moving with a velocity V undergoes a head on collision with another object of mass m_2 at rest. After collision body with mass m_1 comes to the state of rest. Determine the velocity of the body with mass m_2 after collision.
- (1) $\frac{m_1 v}{m_2}$ (2) $m_1 v$
 (3) $\frac{m_1}{v}$ (4) $\frac{v}{m_1}$
7. What is the power developed by an engine in lifting water of 3000 litre from a well 20 m deep in one minute (1 litre water = 10^3 kg; $g = 10 \text{ ms}^{-2}$)? Assume that there is no loss in the conversion of energy.
- (1) 10 kw (2) 100 kw
 (3) 500 kw (4) 1000 kw
8. A wooden block of mass 1950 g is at rest on a smooth horizontal table. A bullet of mass 50 g is fired into the block and gets embedded in it. The velocity with which the bullet strikes the block is 100 ms^{-1} ; find their common velocity.
- (1) 3.5 ms^{-1} (2) 0.625 ms^{-1}
 (3) 1.25 ms^{-1} (4) 2.5 ms^{-1}
9. The bob of a simple pendulum of length 50 cm is pulled to one side such that it makes an angle 30° with the vertical and released. If the mass of the bob is 200 g, the kinetic energy at the mean position is _____ J. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 0.19 (2) 0.13
 (3) 0.26 (4) 0.49

10. Work done is a _____ quantity.
- (1) vector (2) scalar
 (3) elia mengionless (4) fundamental
11. The momentum of a body of mass 0.5 kg dropped from a certain height (h), when reaches the ground is 10 N s. The value h is _____ m. (take $g = 10 \text{ ms}^{-2}$)
- (1) 20 (2) 40
 (3) 10 (4) 80
12. The relation between momentum (P), mass (m), kinetic energy (KE) and velocity (V) of two bodies is
- (1) $P_1 V_1 = P_2 V_2$ where KE is constant.
 (2) $KE_1 m_1 = KE_2 m_2$ where P is constant.
 (3) $KE_1 P_2^2 = KE_2 P_1^2$ when m is constant.
 (4) All the above
13. The relation between momentum (P), mass (m), kinetic energy (KE) and velocity (V) of a body is
- (1) $PV = 2KE$ (2) $KE = \frac{P^2}{2m}$
 (3) $P^2 = 2mKE$ (4) All the above
14. A force of 5 N acting on a body produces a displacement of 2 m in it. If the force acts at an angle 60° to the displacement then calculate the work done by the force.
- (1) 10 J (2) 15 J
 (3) 5 J (4) 25 J
15. Find the power of a machine gun that can fire 240 bullets per minute, each weighing 50 g, with a velocity of 100 ms^{-1} .
- (1) 10 kW (2) 1 kW
 (3) 5 kW (4) 7 kW
16. A bullet of mass 50 g is fired into a wooden block of mass 1.95 kg placed on a horizontal wooden surface. On striking, the bullet is embedded into the block and both together cover a distance of 200 m in a straight path before coming to rest. Given the coefficient of friction between the block and the surface is 0.2 and the mass of the rifle from which the bullet is triggered is 14 kg, find the magnitude of the velocity of the recoil of the rifle. (Neglect the resistance of air on the bullet).
- (1) 2 ms^{-1} (2) 4 ms^{-1}
 (3) 6 ms^{-1} (4) 12 ms^{-1}
17. Two loads of 40 kgwt and 60 kgwt sit on either ends of a see-saw of length 3 m which is supported at its

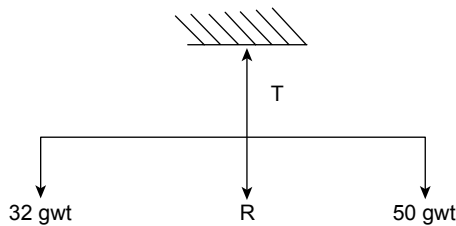
centre. A third load of 30 kgwt should be placed at ____ m from 40 kgwt so as to balance the see-saw?

- (1) 5 (2) 0.5
(3) 1 (4) 3

18. Calculate the resistance offered by a lemon when an effort of 0.06 N is applied. The effort arm of the squeezer is 10 cm and the load arm is 3 cm. Assume that the effort is applied at the end of the effort arm.

- (1) 0.2 N (2) 0.1 N
(3) 0.03 N (4) 0.02 N

19. Two forces act on either side of a rigid body of negligible mass suspended by string as shown in the figure. If R is the resultant force the tension of the string $T = \text{_____ gwt}$.



- (1) 26 (2) 41
(3) 82 (4) 16

20. The mechanical advantage of an inclined plane 2 m long and 1 m high is equal to ____.

- (1) 6 (2) 4
(3) 3 (4) 2

21. Wheel and axle is a lever of ____ order.

- (1) fourth (2) second
(3) first (4) third

22. The mechanical advantage of an inclined plane is always greater than ____.

- (1) ≥ 1 (2) > 1
(3) < 1 (4) $= 1$

23. The mechanical advantage of an inclined plane of angle of inclination 60° is equal to ____.

- (1) $\frac{2}{\sqrt{3}}$ (2) $\csc 30$
(3) Both (1) and (2) (4) None of the above

24. While opening a tap with two fingers, the forces applied are

- (1) equal in magnitude.
(2) parallel to each other.

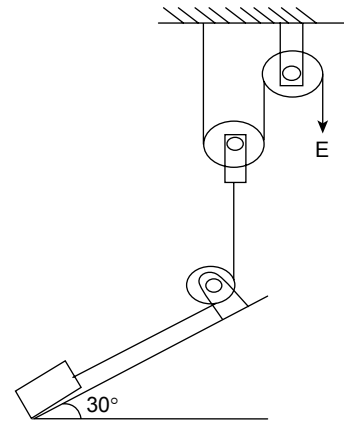
- (3) opposite in direction.

- (4) All the above

25. Determine the maximum angle through which a cube resting on one of its faces can be tilted so that it can regain its original position.

- (1) 90° (2) 430
(3) 45° (4) 60°

26. An object of mass 50 kg is lifted by using an arrangement as shown in the figure. If the load due to the weight of the pulley and the resistance due to the friction of the pulley is 2.5 kgwt, calculate the effort required to lift the object.



- (1) 26.5 kgwt (2) 13.75 kgwt
(3) 36.25 kgwt (4) 72.25 kgwt

27. A car takes a turn along a curved road of radius 40 m and the angle of banking of the road is 45° . At what maximum speed can the car be driven so that it may not skid. ($g = 10 \text{ ms}^{-2}$)

- (1) 20 ms^{-1} (2) 10 ms^{-1}
(3) 5 ms^{-1} (4) 1 ms^{-1}

28. A block of mass 150 g moves with a uniform speed in a circular groove of radius 30 cm. Find its centripetal acceleration and centripetal force acting on the block if the linear speed of the block is 0.8 ms^{-1} .

- (1) 3.2217 N (2) 22.51 N
(3) 3.1451 N (4) 0.3195 N

29. The magnitude of the acceleration of a particle revolving in a circular path of a given radius is directly proportional to ____.

- (1) linear speed (2) angular speed
(3) radius (4) Both (1) and (2)

30. A particle moving along a circular path with the uniform angular velocity ' ω ' is under the action of a force 'F' directed towards the centre of the circular path. If the radius of the circular path is doubled without changing the linear velocity, the centripetal force acting on the body would be _____.
 (1) $F/8$ (2) F
 (3) $F/4$ (4) $F/2$
31. A particle moving in a circle of radius 50 cm with a uniform speed, completes a revolution in 40 s. The magnitude of the centripetal acceleration it experiences is _____ cm s^{-2} .
 (1) $3.2 \pi^2$ (2) $6.3 \pi^2$
 (3) $10.2 \pi^2$ (4) $0.13 \pi^2$
32. A particle, moving in a circle of radius 10 cm with a uniform speed, completes a revolution in 4 seconds. The magnitude of the centripetal acceleration it experiences is _____ cm s^{-2} .
 (1) $2.5 \pi^2$ (2) $5 \pi^2$
 (3) $3 \pi^2$ (4) $6 \pi^2$
33. Two particles of equal mass are revolving with the same linear speed on circular paths of radii r_1 and r_2 . The ratio of the centripetal force acting on them will be _____.
 (1) $\frac{r_2}{r_1}$ (2) $\sqrt{\frac{r_2}{r_1}}$
 (3) $\left(\frac{r_1}{r_2}\right)^2$ (4) $\left(\frac{r_2}{r_1}\right)^2$
34. A ball of mass 1 kg is tied to a string of length 2 m and rotated in a circular path with a uniform speed of 10 ms^{-1} . The angular velocity of the body is _____ rad s^{-1} .
 (1) 10 (2) 15
 (3) 5 (4) 25
35. A body of mass 5 kg is revolving along a circle of radius 2 m, with a uniform speed of 4 ms^{-1} . The centripetal force acting on the body is _____ N.
 (1) 35 N (2) zero
 (3) 40 N (4) 20
36. A scooterist takes a turn through the outer edge of a road of width 10 m. The safe velocity and the radius of curvature of the road are 4.9 ms^{-1} and 24.5 m respectively. The speed with which he should drive the scooter to avoid skidding is _____ ms^{-1} .
 (1) $\sqrt{24.96}$ (2) $\sqrt{14.56}$
 (3) $\sqrt{28.91}$ (4) $\sqrt{36.87}$
37. The false statement about universal gravitational constant (G) among the following is _____.
 (1) Its dimensional formula is $[\text{M}^{-1} \text{L}^3 \text{T}^{-2}]$.
 (2) It is a vector quantity.
 (3) Its value is 6.67×10^{-11} .
 (4) Its unit is $\text{N m}^2 \text{kg}^{-2}$.
38. The escape velocity nearer to the surface of a planet of radius 6800 km and mass $8 \times 10^{24} \text{ kg}$ is _____ kms^{-1} .
 (1) 32.5 (2) 21.2
 (3) 12.5 (4) 11.2
39. What should be the new radius of the earth, in order to reduce the escape velocity to half of the present value without changing the mass of the earth?
 (1) $R/2$ (2) $2R$
 (3) $3R$ (4) $4R$
40. If the time period of a planet is decreased by 10%, and the original radius is R . What is the change in the radius of its orbit?
 (1) $\sqrt[3]{32} R$ (2) $\sqrt{34} R$
 (3) $\sqrt[3]{9} R$ (4) $\sqrt[3]{81} R$
41. If a body attains speed equal to the speed of light then find its mass.
 (1) m (2) me
 (3) $m \frac{v}{e}$ (4) infinite
42. The ratio of angular velocities of two satellites revolving around a planet is 2 : 3. Calculate the ratio of the distance between the satellites and the centre of the planet.
 (1) $\sqrt[3]{\frac{6}{17}}$ (2) $\sqrt{\frac{17}{18}}$
 (3) $\sqrt[3]{\frac{16}{9}}$ (4) $\sqrt[3]{\frac{9}{4}}$
43. Given that the mass and the radius of a planet are four times and one-ninth that of the earth respectively and the orbital velocity of an artificial satellite whose orbit is close to the surface of the earth is 7.92 kms^{-1} , the orbital velocity of an artificial satellite orbiting around the planet close to its surface is _____ kms^{-1} .
 (1) 12.11 (2) 47.52
 (3) 36.4 (4) 22.7

44. (a) A force of 5 N causes a displacement of 10 m in its direction. Calculate the work done by the force.

(1) 15 J (2) 25 J
(3) 50 J (4) 200 J

(b) An agent does 4 J of work in 2 s. Find the power of the agent.

(1) 1 W (2) 3 W
(3) 2 W (4) 6 W

45. A wooden block is dropped from the top of a tower of height 200 m. Simultaneously, a bullet is fired from the foot of the tower aiming the block with a velocity of 100 ms^{-1} . Given that the masses of both the block and the bullet, each equal to 100 g and the bullet is embedded in the block, find the maximum potential energy of the system of the block and the bullet. ($g = 10 \text{ ms}^{-2}$) (Neglect the time of impact)

(1) 150 J (2) 450 J
(3) 300 J (4) 250 J

46. What should be the new radius of the earth in order to make the escape velocity to double of the present value without changing the mass of the earth, if the actual radius of the earth is equal to R?

(1) $2/R$ (2) $4/R$
(3) $R/4$ (4) $R^2/2$

47. The magnitude of acceleration due to gravity at an altitude 'h' from earth is equal to its magnitude at a depth 'd'. Find the relation between 'h' and 'd'. If the 'h' and 'd' both increase by 50%, are the magnitudes of acceleration due to gravity at the new altitude and the new depth equal.

(1) $d = h$ (2) $d = 2h$
(3) $h = \frac{d}{3}$ (4) $d = 4h$

48. Two satellites of identical masses orbit the earth at different heights. The ratio of their distances from the centre of earth is $d : 1$ and the ratio of the acceleration due to gravity at those heights is $g : 1$. Then find the ratio of their orbital velocities.

(1) $\sqrt{\frac{g}{d}}$ (2) \sqrt{gd}
(3) \sqrt{g} (4) $(\sqrt{g} d)$

49. Compare the acceleration due to gravity on the surface of a planet, whose mass and diameter are double that of the earth, with the acceleration due to gravity on the surface of the earth.

(1) 1 : 2 (2) 2 : 1
(3) 3 : 4 (4) 4 : 1

50. Let 'A' be the area swept by the radial vector connecting the earth and the sun in April and May months. Then, find the area swept by the same radial vector connecting the earth and the sun in November and December months in terms of A.

(1) A (2) $2A$
(3) $\frac{30A}{31}$ (4) $\frac{31A}{30}$

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

- | | | | | | | | | | | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| 1. | 1 | 2. | 3 | 3. | 1 | 4. | 2 | 5. | 4 | 6. | 4 | 7. | 4 | 8. | 4 | 9. | 2 | 10. | 1 |
| 11. | 1 | 12. | 3 | 13. | 2 | 14. | 2 | 15. | 3 | 16. | 3 | 17. | 3 | 18. | 1 | 19. | 2 | 20. | 1 |
| 21. | 2 | 22. | 1 | 23. | 3 | 24. | 1 | 25. | 3 | 26. | 2 | 27. | 1 | 28. | 2 | 29. | 3 | 30. | 1 |
| 31. | 1 | 32. | 3 | 33. | 2 | 34. | 2 | 35. | 2 | 36. | 1 | 37. | 4 | 38. | 2 | 39. | 3 | 40. | 1 |
| 41. | 2 | 42. | 3 | 43. | 2 | 44. | 4 | 45. | 2 | 46. | 1 | 47. | 1 | 48. | 2 | 49. | 3 | 50. | 4 |

PRACTICE EXERCISE 3 (B)

- [illegible]

Light

SYNOPSIS

- Light is a form of electromagnetic radiation, it doesn't require any material medium to propagate.
- The real images of objects are formed when light rays after reflection (or) refraction meet at a point. If the rays appear to meet when produced backwards, the image formed is virtual.
- (a) Reflection of light: The bouncing of light into the same medium, from which the light ray is incident after striking the objects (or) surfaces is called reflection. There are two types of reflections, i.e., regular and irregular reflections.
- (b) Laws of reflection: The reflection of light rays at a particular point always satisfies the following laws.
 - (i) The angle of incidence is equal to the angle of reflection i.e., $\angle i = \angle r$.
 - (ii) The incident ray, the reflected ray and the normal all lie in the same plane.
- When a plane mirror is rotated through an angle θ about the point of incidence, the reflected ray rotates through an angle 2θ , irrespective of the angle of incidence.
- When two plane mirrors are placed at an angle ' θ ', such that their reflecting surfaces face each other, then total number of images (n) formed is given by

$$n = \frac{360^\circ}{\theta} - 1, \text{ if } \frac{360^\circ}{\theta} \text{ is even and}$$

$$n = \frac{360^\circ}{\theta}, \text{ if } \frac{360^\circ}{\theta} \text{ is odd.}$$

- The ratio of size of an image to the size of its object is known as magnification and it is denoted by 'm'.

$$m = \frac{\text{size of the image}}{\text{size of the object}} = \frac{v}{u} = \frac{\text{image distance}}{\text{object distance}}$$

$$\text{For mirrors } (m) = \frac{-v}{u} \text{ and for lenses } (m) = \frac{v}{u}$$

m is positive for virtual images and m is negative for real images.

- The focal length of a spherical mirror 'f'

$$= \frac{\text{radius of curvature}}{2}.$$

- (a) The mirror formula is given by $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$, where f, u and v are the focal length, object distance and image distance respectively.

- (b) Lens formula is given by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, where f, u and v are the focal length, object distance and image distance respectively. While solving problem, sign convention has to be followed.

Refraction: When a light ray travels from one transparent medium to another, there is a deviation in the path of the light ray at the boundary of separation of the two media due to change in the velocity of light, this phenomena of light is called refraction.

- When light enters from one medium to another medium, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant called refractive index (μ) for a given pair of media and for a given colour of light. This law is known as snell's law

$$\therefore \mu = \frac{\sin i}{\sin r}$$

- (i) The absolute refractive index (μ) of a medium is the ratio of the velocity of light in air or vacuum (c) to its velocity in a given medium (v). $\mu = c/v$
- (ii) If μ_1 and μ_2 are the absolute refractive indices of two media and v_1 and v_2 are the velocities of light in medium one and medium two respectively then, the refractive index of medium 2 with respect to medium 1 is given by ${}^1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2}$

- When an object is placed in an optically denser medium and when it is seen from an optically rarer medium, the object appears to be raised from its actual position and the shift in the position of the object is given by shift (s) = $t \left[1 - \frac{1}{\mu} \right]$, where t = thickness of medium (real depth) and μ = the refractive index of the denser medium with respect to the rarer medium
- $$= \frac{\text{Real depth}}{\text{Apparent depth}}$$

- When a light ray enters from a denser medium to a rarer medium, the angle of incidence for which the angle of refraction is 90° is called the critical angle (C). From snell's law, it can be proved that the refractive index of given denser medium with respect to rarer medium $\mu = \frac{1}{\sin C}$

The refractive index of a prism (μ), when it is in the minimum deviation condition is given by

$$\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\frac{A}{2}}, \text{ where } D = \text{angle of minimum deviation.}$$

A = refracting angle of the prism. If i_1, i_2 are the incident and emergent angles of the prism and r_1, r_2 are the angle of refraction and angle of incidence at the first and the second refracting surfaces respectively, then $i_1 + i_2 - A = d$ and $A = r_1 + r_2$

- If two or more thin lenses are kept in contact, then their equivalent focal length is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \dots \Rightarrow P = P_1 + P_2 + P_3 + \dots$$

where f_1, f_2, f_3, \dots and P_1, P_2, P_3, \dots are focal lengths and powers of the lenses which are in contact.

f-number is defined as the ratio of the focal length of the lens to the diameter of the aperture.

$$\text{f-number} = \frac{\text{focal length of the lens}}{\text{Diameter of the aperture}}$$

For a normal eye, least distance of distinct vision is 25 cm. Infinity is referred to as far point.

When an object is placed between the focus and the optic-centre of lens such that a magnified, virtual, erect image is formed at the least distance of distinct vision (D) then the magnification is given by $m = 1 + D/f$ where f is the focal length of lens.

When an optical system consists of large number of lenses (optical elements), the magnification of the system is the product of magnification of individual systems. Example: In the case of compound microscope, the magnification is given by $m = m_o \times m_e$

m_o = magnification produced by objective.

m_e = magnification produced by eye piece.

Solved Examples

1. Find the radius of curvature of a concave mirror of focal length 15 cm.

☞ **Solution:** Focal length = $1/2$ radius of curvature (R)

Given $f = 15$ cm

$$R = 2f = 2 \times 15 = 30 \text{ cm}$$

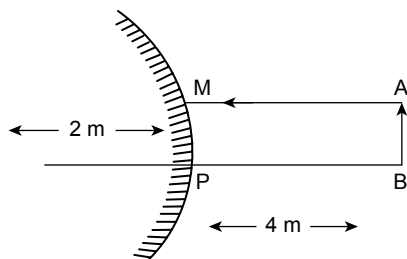
Since it is a concave mirror, ' R ' is negative (from Cartesian sign convention).

2. A rear view mirror of an automobile has a focal length of 2 m. If it locates a person standing at a distance of 4 m from it, find the nature and distance of the image.

☞ **Solution:** Since the mirror is a rear view mirror, it is a convex mirror.

Given Focal length = $f = 2$ m (focal length is positive)

Object distance = $u = -4$ m



∴ From Cartesian sign convention, object distance is in the opposite direction to that of the incident ray

Using mirror formula, we get

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{2} = \frac{1}{-4} + \frac{1}{v} \Rightarrow \frac{1}{v} = \frac{1}{2} + \frac{1}{4}$$

$$\frac{1}{v} = \frac{4+2}{4 \times 2} \Rightarrow \frac{1}{v} = \frac{6}{8} \Rightarrow v = \frac{8}{6} = 1.33 \text{ m}$$

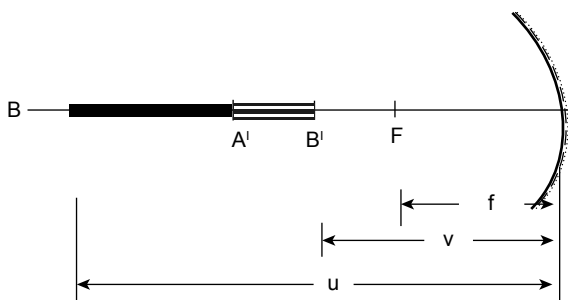
Since v is positive, image is virtual (it is formed at the back of the convex mirror)

$$\text{Magnification } m = \frac{\text{height of the image}}{\text{height of the object}} = -\frac{v}{u};$$

$$m = \frac{-1.33}{-4} = 0.3325 \text{ Since magnification is positive, the image is erect and virtual.}$$

3. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that the end close to the pole is 20 cm away from it. Find the length of the image of the rod.

☞ **Solution:** AB – Object
AB' – Image



Focal length $f = -10$ cm

∴ Radius of curvature $R = 2f = -20$ cm;

Length of the rod AB = 10 cm; Distance of the end A = 20 cm = R ; Since the end of the object 'A' is on the centre of curvature, the image A' will be at 'the same position'.

Distance of the end B = 20 + 10 = 30 cm

∴ $u = -30$ cm (from Cartesian sign convention)

$f = -10$ cm; $\Rightarrow v = ?$

$$\text{From mirror formula } \frac{1}{f} = \frac{1}{u} + \frac{1}{v}; \frac{1}{-10} = \frac{1}{-30} + \frac{1}{v}$$

$$\Rightarrow \frac{1}{v} = \frac{-1}{10} + \frac{1}{30} \Rightarrow \frac{1}{v} = \frac{-30+10}{30 \times 10}$$

$$\frac{1}{v} = \frac{-20}{300}; v = \frac{-30}{2} = -15 \text{ cm}$$

Length of the image = $A'B' = 20 - 15 = 5$ cm

4. The velocity of light in air is $3 \times 10^8 \text{ ms}^{-1}$. If the refractive index of water is $4/3$, find the velocity of light in water.

☞ **Solution:** Given velocity of light in air, $c =$

$$3 \times 10^8 \text{ ms}^{-1} \text{ Refractive index of water } \mu_w = \frac{4}{3};$$

$$\text{Refractive index of water} = \frac{c}{v_w}; \text{ Where } v_w$$

$$\text{is the velocity of light in water; } \frac{4}{3} = \frac{3 \times 10^8}{v_w};$$

$$v_w = \frac{3 \times 3 \times 10^8}{4}$$

$$v_w = 2.25 \times 10^8 \text{ ms}^{-1}$$

Velocity of light in water is $2.25 \times 10^8 \text{ ms}^{-1}$.

5. The angle of incidence of a ray of light is 45° . If a light ray travels from air to glass, find the angle of refraction. Refractive index of glass, $\mu_g = 1.5$

☞ **Solution:** Given $i = 45^\circ =$ angle of incidence

Refractive index of glass = $\mu_g = 1.5$ Angle of refraction $r = ?$

$$\mu_g = \frac{\sin i}{\sin r} \text{ (from Snell's law);}$$

$$1.5 = \frac{\sin 45}{\sin r} \Rightarrow 1.5 = \frac{\frac{1}{\sqrt{2}}}{\sin r} \Rightarrow \sin r = \frac{1}{1.5 \times \sqrt{2}}$$

$\sin r = 0.4728$. From sine trigonometric table, we get $r \approx 28^\circ$.

6. Refractive index of diamond is 2.5 and that of glass is 1.5. Calculate the refractive index of diamond with respect to glass.

☞ **Solution:** Refractive index of glass $\mu_g = 1.5$; Refractive index of diamond $\mu_d = 2.5$; From relative refractive index; ${}^g\mu_d = \frac{\mu_d}{\mu_g} = \frac{2.5}{1.5} = 1.667$

7. A coin placed in a beaker containing water appears at a depth of 3 cm from the water surface. What is the real depth of the coin? Refractive index of water = 4/3

☞ **Solution:** Real depth = ?; Apparent depth = 3 cm

Refractive index of water = 4/3;

Refractive index = $\frac{\text{real depth}}{\text{apparent depth}}$;

$$\Rightarrow \frac{4}{3} = \frac{\text{real depth}}{3}; \frac{4}{3} \times 3 = \text{real depth},$$

\therefore Real depth = 4 cm

8. A bird flying above a pond starts moving vertically down towards the water below at a speed of 6 ms^{-1} . Find its apparent velocity as viewed by a fish located at a depth of 2 m below the surface of water. Refractive index of water is 4/3.

☞ **Solution:** Let the initial height of the bird above the surface of water be h_1 and the apparent height be h_1' .

Thus we have,

$$\frac{\mu_{\text{air}}}{\mu_{\text{water}}} = \frac{\text{real height in air}}{\text{apparent height in air}}$$

$$\therefore \frac{1}{\mu} = \frac{h_1}{h_1'}$$

$$\text{i.e., } h_1' = \mu h_1$$

Let the final height of the bird after t be h_2 and the corresponding apparent height be h_2' .

$$\therefore \frac{1}{\mu} = \frac{h_2}{h_2'}$$

$$\therefore h_2' = \mu h_2$$

$$\begin{aligned} \text{apparent displacement} &= h_2' - h_1' \\ &= \mu (h_2 - h_1) \rightarrow (1) \end{aligned}$$

$$\text{Apparent velocity, } v' = \frac{h_2' - h_1'}{t};$$

$$\text{Real velocity } v = \frac{h_2 - h_1}{t}$$

From these two relations we have $\frac{v'}{v} = \frac{h_2' - h_1'}{h_2 - h_1}$
combining with equation (1)

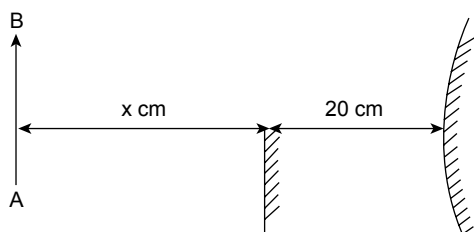
$$v' = v \frac{\mu(h_2 - h_1)}{(h_2 - h_1)} = \mu v = \frac{4}{3} \times 6 = 8 \text{ ms}^{-1}$$

since μ is greater than one, $v' > v$, i.e., the bird appears to move down faster.

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- The velocity of light in air is $3 \times 10^8 \text{ ms}^{-1}$ wavelength of visible light is 400 nm to 800 nm (4000 \AA to 8000 \AA). Its corresponding frequency is _____ Hz to _____ Hz .
 (1) $7 \times 5 \times 10^{14}$, 3.75×10^{14}
 (2) 6.3×10^{14} , 2.3×10^{14}
 (3) 3×10^{14} , 8×10^{14}
 (4) 0.4×10^{-8} , 0.8×10^{-8}
- Ram was playing with a convex mirror and a plane mirror. When an object AB is placed in front of the mirrors he could see two virtual images. When the object is placed at a position as shown in the figure, he found that both the images coincide with each other. If the focal length of the convex mirror is 30 cm, find the value of 'x'.

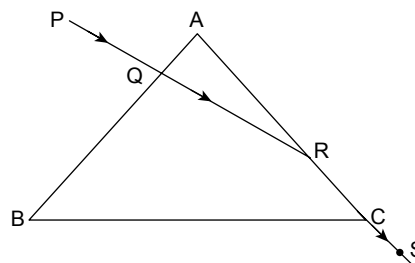


- (1) 80 cm
 (3) 60 cm
- (2) 40 cm
 (4) 30 cm
- An observer moves towards a stationary plane mirror at a speed of 4 ms^{-1} . Determine the velocity of image with respect to the mirror.
 (1) 8 ms^{-1}
 (3) 2 ms^{-1}
- (2) 4 ms^{-1}
 (4) 16 ms^{-1}
- A convex mirror of radius of curvature 2 m is used as rear-view mirror in an automobile. If a vehicle of size 1 m is at a distance of 5 m from the mirror, the image distance and magnification produced by the mirror are ____ m and ____ respectively.

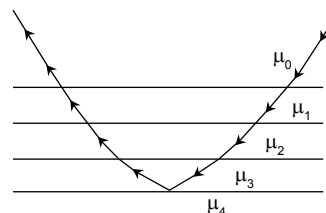
- (1) $\frac{5}{6}, \frac{1}{6}$
 (3) $\frac{6}{5}, \frac{7}{6}$
- (2) $\frac{6}{7}, \frac{1}{5}$
 (4) $\frac{1}{5}, \frac{1}{6}$

- In an equilateral prism if the angle of incidence for minimum angle of deviation is 35° , then what is the minimum angle of deviation?
 (1) 30°
 (3) 10°
- (2) 20°
 (4) 45°
- Two light rays of different wavelengths λ_1 and λ_2 fall respectively, on two glass slabs S_1 and S_2 normally and come out of the glass slabs simultaneously. If $\lambda_1 > \lambda_2$, and if t_1 and t_2 are the thickness of the glass slabs s_1 and s_2 respectively, which among the following is the correct relation between them?
 (1) $t_1 = t_2$
 (3) $t_1 > t_2$
- (2) $t_1 < t_2$
 (4) $t_1 \geq t_2$

- ABC represents the principal cross-section of an equilateral prism made with a transparent material. If PQRS indicates the path of a light ray, find the refractive index of the material.



- (1) $\frac{1}{\sqrt{2}}$
 (3) $\sqrt{2}$
- (2) $\frac{2}{\sqrt{3}}$
 (4) $\frac{\sqrt{3}}{2}$
- A ray of monochromatic light follows the path shown in the figure as it passes through five layers of different optical media of refractive indices $\mu_0, \mu_1, \mu_2, \mu_3$ and μ_4 . If the angle of incidence in the first medium is 30° , determine the angle of deviation on the whole.



- (1) 60°
 (3) 30°
- (2) 120°
 (4) 45°

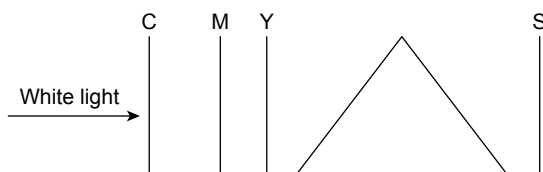
9. A bird is flying 12 m above the surface of a pond. What is the apparent position of the bird as viewed by a fish 1 m below the surface? (${}_a\mu_w = \frac{4}{3}$)

(1) 15 m (2) 17 m
(3) 13 m (4) 16 m

10. In which colour, a yellow coloured dress would appear when viewed through a blue filter?

(1) red (2) blue
(3) yellow (4) black

11. Three filters, one of cyan (C), one of magenta (M) and the last, yellow (Y) are placed in front of a 100% transparent equilateral glass prism as shown in the figure. A screen (S) is placed on the other side of the prism. When a white light ray is allowed to pass through the filters as shown in the figure and incident on the prism, what colours are obtained on the screen?

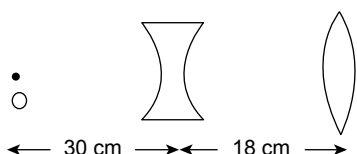


(1) cyan (2) white
(3) black (4) yellow

12. A convex lens of focal length 0.12 m produces a virtual image which is thrice the size of the object. Find the distance between the object and the lens.

(1) 0.04 m (2) 0.08 m
(3) 0.12 m (4) 0.24 m

13. An object (O) is placed in front of a concave lens of focal length 20 cm as shown in figure. Determine the focal length of the convex lens if a real image is formed at a distance of 30 cm by the convex lens.



(1) 15 cm (2) 30 cm
(3) 45 cm (4) 60 cm

14. The focal lengths of the eye piece and objective lens of a compound microscope are 10 cm and 20 cm

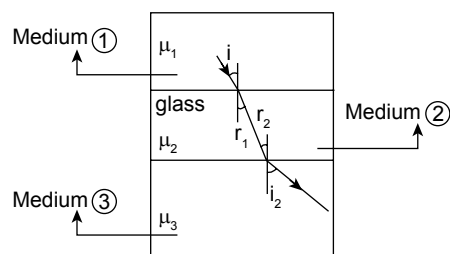
respectively. If the length of the tube is 100 cm, what is the magnification obtained at the least distance of distinct vision?

(1) 25 (2) 12.5
(3) 50 (4) 60

15. An object of length 2 cm is placed at distance 2.5 f from a concave mirror where 'f' is its focal length. Find the length of the image.

(1) 2.33 cm (2) 0.88 cm
(3) 0.66 cm (4) 1.33 cm

- 16.



Consider the figure and select the correct statements from the following.

- (1) Since, $\sin i_1 \neq \sin i_2$, the emergent ray in medium (3) is parallel to the incident ray in medium (1).
(2) The optical density of medium (3) is less than the optical density of medium (1).
(3) The optical density of medium (2) is greater than that of both media (1) and (3).
(4) Both (2) and (3)

17. Choose the correct statement.

- (A) The angle of deviation for Indigo is greater than the angle of deviation of the orange colour.
(B) The angle of deviation increases with increase in the wavelength of the incident light.
(1) Only A is true.
(2) Only B is true.
(3) Both A and B are true.
(4) Both A and B are false.

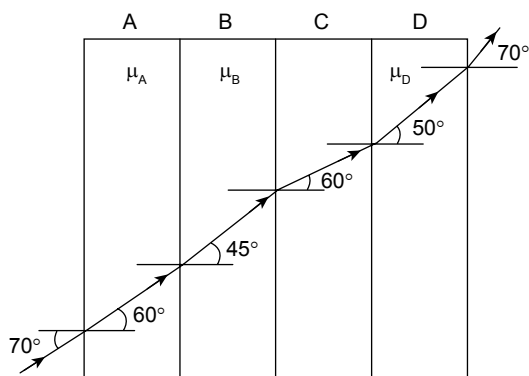
18. Two convex lenses A and B of focal lengths 0.3 m and 0.2 m respectively are placed in contact. Calculate the effective power of the combination.

(1) 36/7 D (2) 25/3 D
(3) 3/25 D (4) 63/11 D

19. An object is placed on the principal axis of a convex mirror of focal length 15 cm. If the distance of the

object from the mirror is 30 cm, determine the image distance.

- (1) 15 cm (2) 20 cm
(3) 10 cm (4) 30 cm
20. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm. Determine the ratio of the size of the image and the size of object.
- (1) 2 : 1 (2) 1 : 2
(3) 1 : 1 (4) 4 : 1
21. The reflected ray from a plane mirror is incident on another plane mirror which is placed perpendicular to the first. If the angle of incidence on the first mirror is 30° , determine the glancing angle of reflection on the second mirror.
- (1) 15° (2) 120°
(3) 60° (4) 30°
22. An object is placed at a distance of 20 cm from a convex mirror of radius of curvature 40 cm. At what distance from the object should a plane mirror be placed so that the images due to the mirror and the plane mirror are in the same plane?
- (1) 15 cm (2) 30 cm
(3) 60 cm (4) 40 cm
23. A diver under water sees a bird in air, vertically above him. If the actual height of the bird above the water surface is h , If μ_w is the refractive index of water, find the shift in the bird's position as observed by the diver.
- (1) $h(\mu_w - 1)$ (2) $\mu_w h$
(3) $(\mu_w + 1)h$ (4) $\frac{\mu_w - 1}{h}$
24. A, B, C and D are four transparent sheets of equal thickness and made of material of refractive indices μ_A , μ_B , μ_C and μ_D . If a light ray propagates through them as shown in the figure, which among the following is the correct relation?



- (1) $\mu_A > \mu_B > \mu_C > \mu_D$
(2) $\mu_A = \mu_C < \mu_D < \mu_B$
(3) $\mu_A < \mu_B < \mu_D < \mu_C$
(4) $\mu_A = \mu_B = \mu_C = \mu_D$
25. A convex lens and a convex mirror are separated by a distance of 10 cm such that the reflecting surface of the mirror faces the lens. The image of an object placed in front of the convex lens at a distance of 20 cm is found to coincide with the object. If the focal length of the convex lens is 15 cm, determine the focal length of the mirror.
- (1) 35 cm (2) 30 cm
(3) 15 cm (4) 25 cm
26. A telescope has an objective of focal length 100 cm and eye piece of focal length 6 cm and the least distance of distinct vision is 25 cm. The telescope is focused for distinct vision of an object at a distance 100 m from the objective. What is the distance of separation between the objective and the eye piece?
- (1) 2.5 m (2) 1.5 m
(3) 1.06 m (4) 98 cm
27. A student with a normal eye observes the reading on a vernier scale using a magnifying glass of focal length 10 cm. What are the minimum and the maximum distances between the scale and the magnifying glass at which he can read the scale when viewing through the magnifying glass?
- (1) 7.14 cm, ∞ (2) 7.14 cm, 10 cm
(3) 10 cm, 20 cm (4) 25 cm, ∞
28. When the photograph of an object is taken by using a pinhole camera the magnification is found to be 0.05. When the pin hole camera is moved through a distance 2 m towards the object the magnification is found to be 0.0625. Determine the width of the pin hole camera.
- (1) 30 cm (2) 120 cm
(3) 60 cm (4) 50 cm
29. An object is placed at 40 cm from the optic centre of a convex lens on its principal axis. If the focal length of the lens is 24 cm, find how far from the lens the screen should be placed to obtain a well-defined image.
- (1) 48 cm (2) 38 cm
(3) 50 cm (4) 60 cm
30. A concave mirror is made from a hollow sphere of radius of curvature 30 cm. If an object of height

2 cm is placed at 10 cm from the pole of the mirror, determine the size of the image.

- (1) 3 cm (2) 6 cm
(3) 12 cm (4) 24 cm

31. Facts about the light

(A) Light is a form of electromagnetic radiation and a non-mechanical wave.

(B) Light waves do not require a material as a medium for propagation.

- (1) Only A is true.
(2) Only B is true.
(3) Both A and B are true
(4) Both A and B are false

32. When a light ray is directed towards the principal focus of a concave mirror

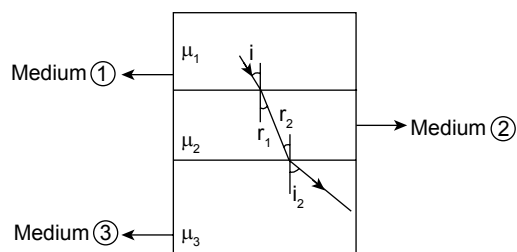
- (1) real image is formed
(2) a diminished image is formed
(3) inverted image is formed
(4) All the above

33. Total reflecting prisms are _____ prism.

- (1) right angled.
(2) acute angled isosceles.

- (3) right angled isosceles.
(4) obtuse angled isosceles.

34. Light is made to travel from medium 1 to medium 3 through medium 2 as shown in figure. If μ_1 , μ_2 and μ_3 are the refractive indices of first, second and third media and $i_2 > i_1$, then



- (1) $\sin r_1 = \sin r_2$; $\sin i_1 < \sin i_2$.
(2) ${}^1\mu_2 > {}^2\mu_1$; $\mu_3 < {}^3\mu_2$.
(3) ${}^1\mu_3 < {}^3\mu_1$.
(4) All the above

35. The lateral displacement depends on _____.

- (1) thickness of the medium
(2) refractive index of the medium
(3) angle of incidence
(4) All the above

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. An object of height 10 cm is placed at a distance of 100 cm before the convex mirror perpendicular below the principal axis. If the focal length of the mirror is 10 cm, on applying the Cartesian sign convention, find the object distance.

- (1) -100 cm (2) +100 cm
(3) 50 cm (4) -50 cm

2. An object is placed on the principal axis of a concave mirror at a distance of 60 cm. If the focal length of the concave mirror is 40 cm then determine the magnification of the obtained image.

- (1) 4 (2) -2
(3) -4 (4) +2

3. A convex mirror of radius of curvature 4 m is used as rear-view mirror in an automobile. If a vehicle of size

4 m is at a distance of 5 m from the mirror, what is the position of the image and size of the image?

- (1) $\frac{5}{6}$ m, $\frac{1}{6}$ m (2) $\frac{10}{7}$ m, $\frac{4}{7}$ m
(3) $\frac{6}{5}$ m, $\frac{1}{16}$ m (4) $\frac{10}{13}$ m, $\frac{4}{17}$ m

4. A light ray travels from optically denser medium to optically rarer medium, if the angle of incidence and refraction at point of incidence are $\angle i$ and $\angle r$ respectively, then find the angle of deviation in terms of $\angle i$ and $\angle r$.

- (1) $\angle i + \angle r$ (2) $\frac{\angle i}{\angle r}$
(3) $\angle i - \angle r$ (4) $\angle r - \angle i$

5. The apparent vertical shift of the image of a coin placed at the bottom of a container filled with a liquid having depth d and refractive index ' μ ' is _____

- (1) $d\mu$ (2) $\left(\mu - \frac{1}{d}\right)$
 (3) $d\left(1 - \frac{1}{\mu}\right)$ (4) $d(\mu + 1)$

6. The refractive index of a given glass is $\sqrt{2}$, find the angle of minimum deviation produced by an equilateral prism made of this glass.

- (1) 60° (2) 30°
 (3) 45° (4) 15°

7. μ_1, μ_2 are the refractive indices of two media A and B. If $\mu_1 > \mu_2$, when two light rays travel from air to medium A and air to medium B with the same angle of incidence then the angle of refractions are r_1 and r_2 respectively. What is the relation between r_1 and r_2 ?

- (1) $r_1 = r_2$ (2) $r_1 < r_2$
 (3) $r_1 > r_2$ (4) $r_1 \geq r_2$

8. The critical angle for a medium X is 60° and for another medium Y is 45° . Calculate the ratio of velocity of light in the medium X to that in medium Y.

- (1) $\sqrt{\frac{2}{3}}$ (2) $\sqrt{\frac{3}{2}}$
 (3) $1:1$ (4) $\sqrt{\frac{1}{2}}$

9. The power of a lens is $+8$ D. What kind of lens is this?

- (1) Convex (2) Concave
 (3) Concavo convex (4) Convexo concave

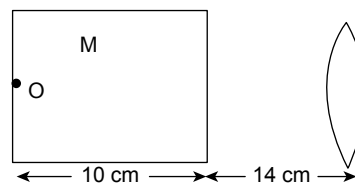
10. What is the colour of a green leaf, when white light passing through a yellow filter is incident on it?

- (1) black (2) blue
 (3) yellow (4) green

11. A ray of white light is incident on a green pigment after passing through a magenta filter. The reflected ray is allowed to pass through a cyan filter. What would be the colour of the emergent ray? Comment on the brightness of the emergent ray.

- (1) dark green (2) dark blue
 (3) dull blue (4) dull green

12. An object (O) is placed in a medium M of refractive index $5/3$. A convex lens of focal length 15 cm is placed in front of the object as shown in the figure. Determine the position of the image formed by the lens.

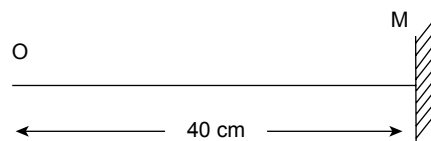


- (1) 15 cm (2) 20 cm
 (3) 30 cm (4) 60 cm

13. An object is placed at a distance 20 cm in front of a concave lens of focal length 10 cm. Where should a plane mirror be placed so that the image formed on the plane mirror coincides with the image formed on the concave mirror.

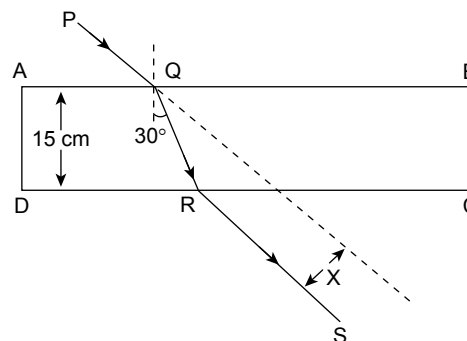
- (1) $20/3$ cm (2) $10/3$ cm
 (3) 10 cm (4) 20 cm

14. An object (O) and a plane mirror (M) are placed in the positions as shown in the figure. If the object and the mirror move simultaneously towards side in a straight path at uniform speeds of 2 cm s^{-1} and 5 cm s^{-1} respectively, find the shift in the position of the image of the object at the end of 10 seconds.



- (1) 160 cm (2) 140 cm
 (3) 80 cm (4) 120 cm

15. ABCD represents a glass slab and PQRS indicates the path of a light ray passing through the slab. If the refractive index of the glass is $\sqrt{3}$, find the lateral displacement (x).



- (1) 15 cm (2) 16.33 cm
 (3) 8.66 cm (4) 12.33 cm

16. If the speed of light in medium – 1 and medium – 2 are $2.5 \times 10^8 \text{ ms}^{-1}$ and $2 \times 10^8 \text{ ms}^{-1}$ respectively then what is the refractive index of medium – 1 with respect to medium – 2?
- (1) $\frac{4}{5}$ (2) $\frac{3}{2}$
 (3) $\frac{4}{3}$ (4) $\frac{3}{4}$
17. Determine the refractive index of an equilateral prism if the angle of minimum deviation is 30° .
- (1) $\sqrt{3}$ (2) $\frac{\sqrt{3}}{2}$
 (3) $\sqrt{\frac{3}{2}}$ (4) $\sqrt{2}$
18. A tree, which is 200 m away from the pinhole, produces an image of height 1 cm, in a pinhole camera of width 20 cm. Find the height of the tree.
- (1) 30 m (2) 20 m
 (3) 10 m (4) 40 m
19. Two plane mirrors X and Y are placed parallel to each other and are separated by a distance of 20 cm. An object is placed between the two mirrors at a distance 5 cm from the mirror X. Find the distance of the first three images formed in the mirror X.
- (1) 5 cm, 30 cm, 40 cm
 (2) 5 cm, 35 cm, 45 cm
 (3) 10 cm, 45 cm, 65 cm
 (4) 5 cm, 45 cm, 85 cm
20. A rod of length $f/2$ is placed along the axis of a concave mirror of focal length f . If the near end of the real image formed by the mirror just touches the far end of the rod, find its magnification.
- (1) 4 (2) 3
 (3) 1 (4) 2
21. Determine time taken for the sunlight to pass through a window glass of 5 mm thickness when incident normally. ($\mu_{\text{glass}} = 1.5$)
- (1) $4 \times 10^{-7} \text{ s}$ (2) $2 \times 10^{-8} \text{ s}$
 (3) $2.5 \times 10^{-11} \text{ s}$ (4) $3 \times 10^{-8} \text{ s}$
22. A light ray passes from air to denser medium of certain thickness and emerges on the other side. If the emergent ray is parallel to the incident ray, the distance travelled by the ray of light in the denser medium is 6 cm, and the angle of incidence and refraction are 60° and 30° respectively, find the lateral displacement of the light ray.
- (1) 9 cm (2) 2 cm
 (3) 3 cm (4) 6 cm
23. A lean boy named Ramesh placed a glass slab of refractive index $3/2$ on his photograph. He felt it more interesting as his face appeared bigger than the original size, when observed from the top of the glass slab. He also observed that the photo appears at a height of 1.5 cm from the bottom. He then placed another glass cube made of different material and having the same thickness over the first glass cube. Now, he himself started to laugh by seeing his photograph as it appeared still bigger than the previous. When observed from the top the photograph appears to be at a height of 4 cm from the bottom. Determine the refractive index of the second glass cube.
- (1) 1.5 (2) 2.25
 (3) 3.75 (4) 1.75
24. A cyan colour light ray is passed through a blue filter. What is the colour of the light which comes out through the filter?
- (1) green (2) cyan
 (3) yellow (4) blue
25. The ciliary muscles can change the focal length of the eye lens. Find the ratio of focal lengths of the eye lens when it is focused on two different objects, one at a distance of 2 m and the other at a distance of 1 m. The diameter of normal eye is 2.5 cm.
- (1) 17 : 16 (2) 42 : 41
 (3) 41 : 42 (4) 82 : 81
26. A light ray is incident at one face of an equilateral prism such that the angle of incidence is 45° . If the light ray emerges from the other face of the prism by making the same angle with the normal, determine the refractive index of the material of the prism.
- (1) $\sqrt{\frac{3}{2}}$ (2) $\frac{\sqrt{3}}{2}$
 (3) $\sqrt{3}$ (4) $\sqrt{2}$
27. In an optical instrument a convex lens of focal length 20 cm is used and kept in contact with a concave lens of focal length 40 cm. What is the power of this combination?
- (1) 4.5 D (2) 3.5 D
 (3) 1.5 D (4) 2.5 D

28. Light rays from the sun after reflection at a plane mirror pass through a hole in a wall. After some time due to the shift in the position of the sun, the angle of incidence of sun light increases by 10° . By what angle should the mirror be rotated such that the reflected rays continue to pass through the hole in the wall?
- (1) 20° (2) 15°
(3) 5° (4) 10°
29. A convex mirror is used
- (1) by a dentist.
(2) for shaving.
(3) as a rear view mirror in vehicles.
(4) as a light reflector for obtaining a parallel beam of light.
30. Find the correct statement/s related to the image formed by the plane mirror from the given below.
- (1) The image formed is laterally inverted, virtual and erect.
(2) The size of the image is equal to the size of the object.
(3) The object distance from the plane mirror is equal to the image distance from the plane mirror.
(4) All the above
31. The nature of image formed when an object is placed near to a concave lens is ____.
- (1) virtual diminished (2) real magnified
(3) virtual magnified (4) real diminished
32. The final image formed by the refracting periscope is ____ than the reflecting periscope.
- (1) bright (2) sharp
(3) dimmer (4) Both (1) and (2)
33. What are the factors that determine the angle of deviation in a prism?
- (1) Angle of incidence (2) Wavelength
(3) Angle of the prism (4) All the above
34. Astigmatism can be rectified by a suitable ____ lens.
- (1) concave (2) convex
(3) cylindrical (4) None of the above
35. A concave mirror is placed on a table with its pole touching the table. The mirror is rotated about its principal axis in clockwise direction. The image of a person looking straight into it
- (1) rotates in clockwise direction.
(2) rotates in anti-clockwise direction.
(3) is inverted.
(4) does not rotate

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

1. 1	2. 2	3. 2	4. 1	5. 3	6. 3	7. 2	8. 2	9. 2	10. 4
11. 3	12. 2	13. 1	14. 2	15. 4	16. 4	17. 1	18. 2	19. 3	20. 3
21. 4	22. 1	23. 1	24. 2	25. 4	26. 3	27. 2	28. 4	29. 4	30. 2
31. 3	32. 4	33. 3	34. 4	35. 4					

PRACTICE EXERCISE 4 (B)

1. 1	2. 2	3. 2	4. 4	5. 3	6. 2	7. 2	8. 2	9. 1	10. 4
11. 3	12. 4	13. 1	14. 1	15. 3	16. 1	17. 4	18. 3	19. 2	20. 4
21. 3	22. 3	23. 2	24. 4	25. 4	26. 4	27. 4	28. 3	29. 3	30. 4
31. 1	32. 4	33. 4	34. 3	35. 4					

Electricity

SYNOPSIS

- The branch of electricity which deals with the phenomena related to or applications regarding charges at rest is known as 'static electricity'.

Charge on any body $q = ne$. Where n is the number of electrons and e is the charge of an electron.

- The force of attraction or repulsion between charges is given by Coulomb's law.

$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$, where q_1 and q_2 are the magnitudes of charges, r is the distance between the charges and ϵ_0 is the permittivity of free space or air.

- 'Electric field' is the region surrounding a charged body where its effect is felt by another charged body. Unit of electric field strength is N C^{-1} and its dimensional formula is $[\text{ML}^2\text{T}^{-3}\text{A}^{-1}]$.
- The electric potential (V) at a point in an electric field is the work done to move a unit positive charge from infinity to that point in that field. Its unit is volt (V) and its dimensional formula is $[\text{ML}^2\text{T}^{-3}\text{A}^{-1}]$.
- When one joule of work is done in bringing one coulomb positive charge from infinity to a point in an electric field then electric potential at that point is said to be one volt.

- Capacitance C of a conductor is defined as the ratio of charge (Q) on a conductor to its potential (V).

$$C = \frac{Q}{V}.$$

Unit of capacitance is farad (F).

$$1\mu\text{F} = 10^{-6}\text{F}, 1\text{pF} = 10^{-12}\text{F}.$$

- The rate at which electric charge (q) flows through a conductor is known as electric current (i). $i = \frac{q}{t}$. Its unit is coulomb/second = ampere (A).
- The opposition to electric current through a conductor is called 'electric resistance' (R). Its unit is ohm (Ω).
- The resistance (R) of a conductor is directly proportional to its Length (ℓ) and inversely proportional to its area of cross-section (a). $R \propto \frac{\ell}{a}$, $R = \rho \frac{\ell}{a}$, ρ - specific resistance or resistivity.
Unit of resistivity (ρ) is ohm metre = Ωm .
- The reciprocal of electrical resistance (R) is known as electrical conductance (G), $G = \frac{1}{R}$. Its unit is ohm^{-1} or mho or siemen.
- The reciprocal of resistivity (ρ) is called conductivity (σ), $\sigma = \frac{1}{\rho}$. Its unit is mho metre^{-1} or siemen metre $^{-1}$.
- The resistance of a conductor increases with an increase in the temperature. Let the resistance of a

conductor at 0°C be R_0 , then the resistance (R_t) of the conductor at $t^\circ\text{C}$ is given by $R_t = R_0 (1 + \alpha t)$, where α is known as the temperature coefficient of resistance.

- Ohm's law states that the potential difference (V) applied between the ends of a conductor bears a constant ratio with the electric current (I) flowing through it at constant temperature. $V \propto I$, $V = IR$, R is the resistance of the conductor.
- When resistors of resistances R_1 , R_2 and R_3 are connected in series, the effective resistance (R_{eff}) $R_{\text{eff}} = R_1 + R_2 + R_3$.

When they are connected in parallel,

$$\frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}.$$

- (a) The terminal voltage while discharging a cell $V = E - ir$.
- (b) Terminal voltage while charging a cell $V = E + ir$.
- Heat (H) produced in a conductor when current passes through it is directly proportional to the resistance (R), square of the current (I^2) and the time for which the current flows through the circuit. $H = I^2 R t$.
- If 'W' is the work done in moving a charge 'Q' through a potential difference 'V', then

$$V = \frac{W}{Q}, W = V Q = V I t = I^2 R t = \frac{V^2}{R} t.$$

- The rate at which electric work (W) is done is called electric power (P), $P = \frac{W}{t}$.

Its unit is watt (W). Another unit is horsepower, $1\text{hp} = 746\text{ W}$, $1\text{kW} = 1.34\text{ hp}$.

$$P = \frac{W}{t} = VI = I^2 R = \frac{V^2}{R}.$$

- The commercial unit of electrical energy is kilowatt hour (kW h), $1\text{kW h} = 3.6\text{ MJ}$
 $1\text{kW h} = 1\text{ unit}$.
- Faraday's first law of electrolysis states that the mass (m) of a substance deposited at the cathode is directly proportional to the quantity of electricity (I) and the time (t) for which the current is passed through the electrolyte.
 $m \propto It$, $m \propto Q$, $m = Z Q$
 Z is known as the electrochemical equivalent of the substance.
- The mass of ions liberated at the electrode when 1 coulomb of electricity is passed through the electrolyte is known as e.c.e. It is denoted by Z . $Z = \frac{m}{Q}$.
Units of Z are g C^{-1} or $\text{g A}^{-1} \text{s}^{-1}$.
- According to the Faraday's 1st law of electrolysis, when the same quantity of electricity passes through different electrolytes, the mass of ions liberated at the respective electrodes is proportional to their chemical equivalents.

Solved Examples

- A force of $45 \times 10^{-3}\text{ N}$ acts between two like charge bodies separated by 4 m in the air. If the magnitude of one of the charges is $8\text{ }\mu\text{C}$, find the magnitude of the other charge.

☞ **Solution:** Given $q_1 = 8\text{ }\mu\text{C} = 8 \times 10^{-6}\text{ C}$.
Distance between two charges (r) = 4 m.
Electrostatic force of repulsion (F) = $45 \times 10^{-3}\text{ N}$.
 $q_2 = ?$

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}; \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}.$$

$$\therefore 45 \times 10^{-3} = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times q_2}{(4)^2}$$

$$\Rightarrow q_2 = 10\text{ }\mu\text{C}$$

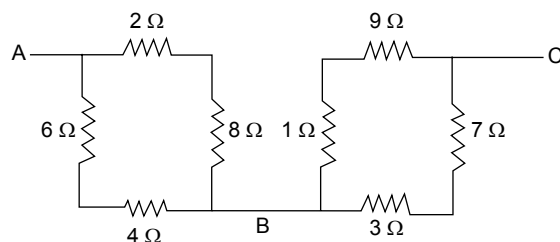
- Electric current passing through a conductor is 5 A. Calculate the number of electrons that pass

through a given cross-section of the conductor in $1\text{ }\mu\text{s}$. The charge of an electron, $e = 1.6 \times 10^{-19}\text{ C}$.

☞ **Solution:** Given, $i = 5\text{ A}$, $t = 1\text{ }\mu\text{s} = 10^{-6}\text{ s}$; $e = 1.6 \times 10^{-19}\text{ C}$, $n = ?$

$$i = \frac{ne}{t} \therefore n = \frac{it}{e} = \frac{5 \times 10^{-6}}{1.6 \times 10^{-19}} = 3.125 \times 10^{13}.$$

- Find the equivalent resistance between



- (i) A and B
- (ii) B and C
- (iii) A and C

☛ **Solution:** (i) Between A and B four resistors are connected. $2\ \Omega$ and $8\ \Omega$ are connected in series. Their effective resistance = $R_1 = 2 + 8 = 10\ \Omega$. Similarly, $6\ \Omega$ and $4\ \Omega$ are connected in series. Their effective resistance = $R_2 = 6 + 4 = 10\ \Omega$. These R_1 and R_2 are connected in parallel between A and B.

∴ If R_1 is the equivalent resistance between 'A' and 'B'

$$\frac{1}{R^1} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{10} + \frac{1}{10} = \frac{1}{5}$$

$$R^1 = 5\ \Omega.$$

- (ii) Four resistors are connected between B and C. $1\ \Omega$ and $9\ \Omega$ resistors are connected in series. Their equivalent resistance = $R_3 = 1 + 9 = 10\ \Omega$. $3\ \Omega$ and $7\ \Omega$ resistors are also connected in series. Their equivalent resistance = $R_4 = 3 + 7 = 10\ \Omega$.

R_3 and R_4 are connected in parallel between B and C.

∴ If R^{11} is the equivalent resistance between 'B' and 'C'

$$\frac{1}{R^{11}} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10}; R^{11} = 5\ \Omega.$$

- (iii) R^1 and R^{11} are connected in series between A and C.

∴ equivalent resistance between A and C.

$$R = R^1 + R^{11} = 5\ \Omega + 5\ \Omega = 10\ \Omega.$$

4. Show that the resistance across any opposite sides of a cubical structured conductor is inversely proportional to the length of its side.

☛ **Solution:** Let ℓ be the length of the side, 'p' be the resistivity and 'R' be the resistance

$$R = \frac{\rho \ell}{A} = \frac{\rho \times \ell}{\ell^2} = \frac{\rho}{\ell}; \text{ but } \rho \text{ is a constant}$$

$$\therefore R \propto \frac{1}{\ell}$$

∴ Resistance of a cubical structured conductor is inversely proportion to the length of its side.

5. State true or false. A $200\ \text{W} - 220\ \text{V}$ bulb has a greater resistance than a $100\ \text{W} - 200\ \text{V}$ bulb.

☛ **Solution:** False

$$\text{Power (P)} = \frac{(\text{voltage})^2}{\text{resistance}} = \frac{V^2}{R}$$

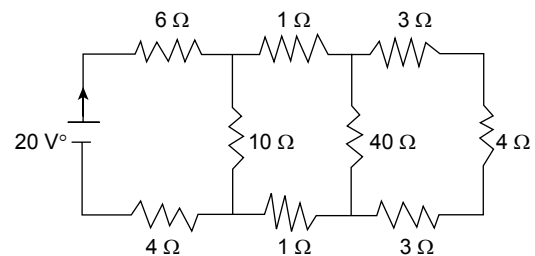
$$P = \frac{V^2}{R} \therefore R = \frac{V^2}{P}$$

$$\text{1st bulb } R_1 = \frac{220 \times 220}{200} = 242\ \Omega.$$

$$\text{2nd bulb } + R_2 = \frac{200 \times 200}{100} = 400\ \Omega$$

The 2nd bulb has more resistance.

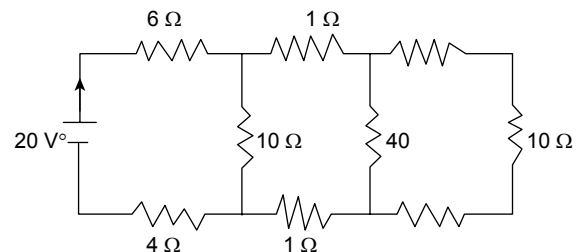
6. In the given circuit, find the power dissipated in the $6\ \Omega$ resistance.



☛ **Solution:** $3\ \Omega, 4\ \Omega, 3\ \Omega$ are in series

The effective resistance is $3 + 4 + 3 = 10\ \Omega$

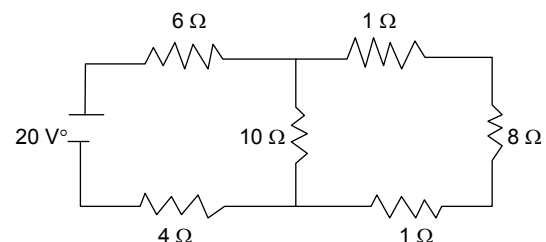
So, the equivalent circuit is



The effective resistance of $40\ \Omega$ and $10\ \Omega$ in parallel is

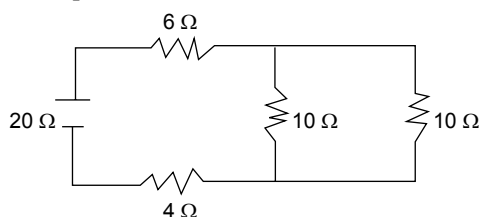
$$\frac{40 \times 10}{40 + 10} = \frac{40 \times 10}{50} = 8\ \Omega$$

The equivalent circuit is



The effective resistance of $1\ \Omega, 8\ \Omega, 1\ \Omega$ in series is $1 + 8 + 1 = 10\ \Omega$

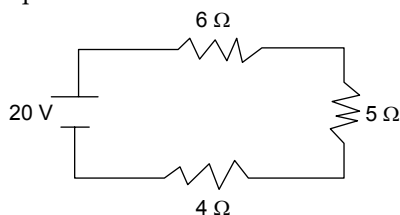
The equivalent circuit is



The effective resistance of 10 Ω, 10 Ω in parallel is

$$\frac{10 \times 10}{10 + 10} = \frac{10 \times 10}{20} = 5 \Omega$$

The equivalent circuit is



∴ The effective resistance is $6 + 5 + 4 = 15$

The current in the circuit, $I = \frac{V}{R}$

$$I = \frac{20}{15}; I = \frac{4}{3} \text{ A}$$

Power dissipated in 6 Ω resistance, $P = I^2 R$

$$= \frac{4}{3} \times \frac{4}{3} \times 6 \Rightarrow P = 10.7 \text{ W}$$

7. Why power transmission is carried at high voltage and low current?

☞ **Solution:** Power transmission is carried out at high voltage and low current to reduce the power loss due to heating effect.

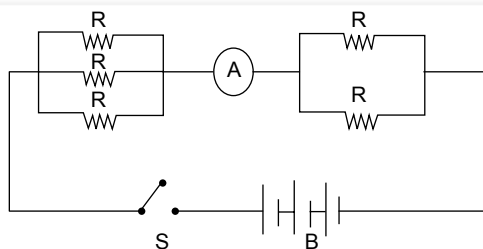
8. The resistors R_1, R_2, R_3, R_4 and R_5 are connected to 15 V battery also with an ammeter A, and a switch 's' in a circuit as shown in the above figure. Find (i) the effective resistance of the circuit and (ii) the total current flowing in the circuit. (Take the values of R_1, R_2, R_3, R_4 and R_5 as 5 Ω, 10 Ω, 15 Ω, 20 Ω and 25 Ω respectively)

☞ **Solution:** Take the effective resistance of R_1, R_2 and R_3 as R^1 .

$$\text{Then, } \frac{1}{R^1} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{5} + \frac{1}{10} + \frac{1}{15}$$

$$\frac{1}{R^1} = \frac{1}{5} \left(\frac{1}{1} + \frac{1}{2} + \frac{1}{3} \right) = \frac{1}{5} \left(\frac{6+3+2}{6} \right) = \frac{11}{30}$$

$$R^1 = \frac{30}{11} \Omega$$



Take the effective resistance of R_4 and R_5 as R^{11} . Then,

$$\frac{1}{R^{11}} = \frac{1}{R_4} + \frac{1}{R_5} = \frac{1}{20} + \frac{1}{25}; \frac{1}{R^{11}} = \frac{45}{20 \times 25} \Rightarrow R^{11} = \frac{100}{9} \Omega$$

The net resistance of the circuit be 'R'. This $R = R^1 + R^{11}$, because these two parallel combinations are connected in series.

$$\Rightarrow R = \frac{30}{11} + \frac{100}{9} = \frac{270 + 1100}{99} = \frac{1370}{99} \Omega$$

By using ohm's law, the current in the circuit would be,

$$i = \frac{V}{R} = \frac{15V}{\frac{1370}{99} \Omega} = \frac{15 \times 99}{1370} = \frac{297}{1370} \text{ A} = 1.1 \text{ A}$$

9. A, B and C are three conductors with capacitances of 0.4 μF, 2.5 μF and 2.5 μF respectively. If the charges on them are 4 μC, 10 μC and 20 μC respectively, find the direction of flow of positive charge when each is connected with the other with a conducting wire.

☞ **Solution:** $V = Q/C$

$$\text{Potential of A} = V_A = \frac{Q_A}{C_A} = \frac{4 \mu\text{C}}{0.4 \mu\text{F}} = 10 \text{ V}$$

$$\text{Potential of B} = V_B = \frac{Q_B}{C_B} = \frac{10 \mu\text{C}}{2.5 \mu\text{F}} = 4 \text{ V}$$

$$\text{Potential of C} = V_C = \frac{Q_C}{C_C} = \frac{20 \mu\text{C}}{2.5 \mu\text{F}} = 8 \text{ V}$$

Positive charge always flows from a body at high potential to a body at low potential. As such, it flows from A to both B and C. Charge also flows from B to C.

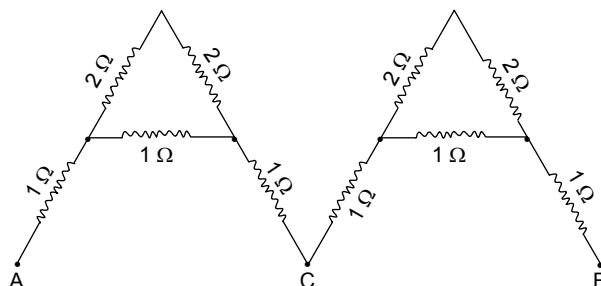
PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. If 100 billion electrons are added to earth, then the potential of the earth _____.
 (1) increases
 (2) decreases
 (3) remains unchanged
 (4) depending on the temperature, the potential changes
2. Two charged bodies with a distance 'd' between them are placed in water and then in air, then the new force between them _____. (Dielectric constant of water is more than one)
 (1) increases
 (2) decreases
 (3) remains the same
 (4) first decreases then increases
3. Find the magnitude of a charge which produces an electric field of strength is $18 \times 10^3 \text{ N C}^{-1}$ at a distance of 5 m in air.
 (1) $50 \mu\text{C}$
 (2) $100 \mu\text{C}$
 (3) $25 \mu\text{C}$
 (4) $250 \mu\text{C}$
4. Calculate the electric field strength at a distance of 3 m from a charge of 32 nC placed in air.
 (1) 8 N C^{-1}
 (2) 32 N C^{-1}
 (3) 64 N C^{-1}
 (4) 16 N C^{-1}
5. The force exerted on a 3 C of charge placed at a point in an electric field is 9 N. Calculate the electric field strength at the point.
 (1) 8 NC^{-1}
 (2) 6 NC^{-1}
 (3) 2 NC^{-1}
 (4) 3 NC^{-1}
6. Find the electric field strength due to $5 \mu\text{C}$ of charge at a point 30 m away from it in air.
 (1) 25 N C^{-1}
 (2) 100 N C^{-1}
 (3) 50 N C^{-1}
 (4) 150 N C^{-1}
7. Calculate the excess number of electrons on each of two similar charged spheres that are located 5 cm apart (in air), such that the force of repulsion between them is $36 \times 10^{-19} \text{ N}$.
 (1) 3262
 (2) 1625
 (3) 6250
 (4) 1547
8. An electrostatic force of attraction between two point charges A and B is 1000 N. If the charge on A is increased by 25% and that on B is reduced by 25% and the initial distance between them is decreased by 25%, the new force of attraction between them is _____ N.
 (1) 1666.67
 (2) 3256.33
 (3) 1253.45
 (4) 3333.3
9. A resistor of 80Ω is connected to a cell and the potential difference across the resistor is 40 V. Then the amount of current that flows through the given resistor is _____ A.
 (1) 0.25
 (2) 0.5
 (3) 5.0
 (4) 2.5
10. If 'n' number of identical resistors of resistance R are connected in parallel combination, then the effective resistance of the combination is _____.
 (1) nR
 (2) $\frac{n}{R}$
 (3) $\frac{R}{n}$
 (4) $nR - \frac{n}{R}$
11. Two wires of resistances 10Ω and 5Ω are connected in series. The effective resistances is _____ Ω .
 (1) 15
 (2) 20
 (3) 30
 (4) 40
12. The ratio of the resistances of two resistors connected in parallel is 2 : 3. The ratio of the currents flowing through them, when this parallel combination is connected to a cell is
 (1) 3 : 2
 (2) 2 : 3
 (3) 1 : 1
 (4) 5 : 3
13. A bulb is connected to a cell and the potential difference across the terminals of the bulb is 24 V. If 3 A of current flows through the bulb, then the resistance of its filament is _____ Ω .
 (1) 8
 (2) 72
 (3) 24
 (4) 3
14. If current of one ampere flows through a conductor, the number of electrons flowing across the cross section of the conductor in 2 seconds is _____. (Take the charge on an electron equal to $1.6 \times 10^{-19} \text{ C}$)
 (1) 1.6×10^{-19}
 (2) 1.25×10^{19}
 (3) 6.25×10^8
 (4) 3.2×10^{18}

15. Calculate the power of an electric bulb which consumes 2400 J in a minute.
 (1) 80 W (2) 120 W
 (3) 60 W (4) 40 W
16. Calculate the electrical energy consumed in units when a 60 W bulb is used for 10 hours.
 (1) 1 (2) 0.6
 (3) 0.3 (4) 2
17. An electric heater has a rating of 3 kW, 220 V. The cost of running the heater for 10 hours at the rate of ₹3.50 per unit is ₹ _____.
 (1) 216 (2) 165
 (3) 209 (4) 105
18. Calculate the effect the resistance when two resistors of resistances $10\ \Omega$ and $20\ \Omega$ are connected in series and parallel.
 (1) $0.15\ \Omega$ (2) $6.66\ \Omega$
 (3) $3.33\ \Omega$ (4) $0.25\ \Omega$
19. The force experienced on an electric charge of 10 C placed at a point in the electric field is 50 N. The strength of the electric field at the point is _____.
 (1) $25\ \text{N C}^{-1}$ (2) $5\ \text{N C}^{-1}$
 (3) $25\ \text{N C}^{-1}$ (4) $30\ \text{N C}^{-1}$
20. The pd across a resistor of resistance $10\ \Omega$, if 10^{20} electrons flow through it in one second is _____ V.
 (1) 160 V (2) 120 V
 (3) 410 V (4) 31 V
21. When a body is rubbed with another body a certain number of electrons are transferred. If the same number of electrons are allowed to flow through the cross section of a conductor in 2 s, 10 A electric current can flow through it. Determine the number of electrons transferred.
 (1) 215×10^{18} (2) 16×10^{18}
 (3) 675×10^{19} (4) 125×10^{18}
22. A current of 5 A flows through a conductor. Calculate the number of electrons flowing through the conductor in 2 s. [Take charge of electron as $1.6 \times 10^{-19}\ \text{C}$]
 (1) 1.6×10^{19} (2) 6.25×10^{19}
 (3) 125×10^{18} (4) 16×10^{19}
23. By using six resistors of resistances $1\ \Omega$ and four resistors of resistance $2\ \Omega$, Rakesh constructed two identical letters A and connected them as shown in the circuit. Rakesh needs to determine the current

flowing through the circuit when this is connected in a circuit. For that, he first determined the effective resistance between A and B. Can you help Rakesh determine the value of the effective resistance?



- (1) $3.2\ \Omega$ (2) $1.6\ \Omega$
 (3) $2.8\ \Omega$ (4) $5.6\ \Omega$
24. A charged particle carrying electric charge of $+10\ \mu\text{C}$ is to rest on the horizontal surface of a table when another charged particle carrying a charge of $+20\ \mu\text{C}$ is at a distance of 20 m from $10\ \mu\text{C}$. Determine the magnitude and direction of the frictional force acting on the charged particle placed on the table.
 (1) $45 \times 10^{-4}\ \text{N}$ (2) 90×10^{-2}
 (3) 9×10^{-4} (4) 18×10^{-4}
25. An electric bulb of 15 V is connected to a battery of 15 V which has negligible resistance. If the resistance offered by the bulb is $5\ \Omega$ the power of the bulb is _____ W.
 (1) 225 (2) 75
 (3) 30 (4) 45
26. If i is the current flowing through a conductor of resistance R for time t , then the heat produced (Q) is given by _____.
 (1) $\frac{i^2 R}{t}$ (2) $\frac{i R^2}{t}$
 (3) $i^2 R t$ (4) $i R t^2$
27. A fuse wire should have _____.
 (1) high resistance
 (2) low melting point
 (3) Both (1) and (2)
 (4) None of these
28. One kilowatt is equal to _____ horse power.
 (1) 1.34 (2) 1.32
 (3) 1.28 (4) 1.38

29. When a current of 5 A flows through a uniform conductor of resistance $10\ \Omega$ for 5 s, find the heat produced in the conductor.

(1) 2500 J (2) 250 J
(3) 1250 J (4) 625 J

30. Why is heat generated in a resistor of resistance $200\ \Omega$, when 10 A current is passed through it for 20 s is _____ J?

(1) 4×10^5 (2) 2×10^5
(3) 3×10^6 (4) 4×10^6

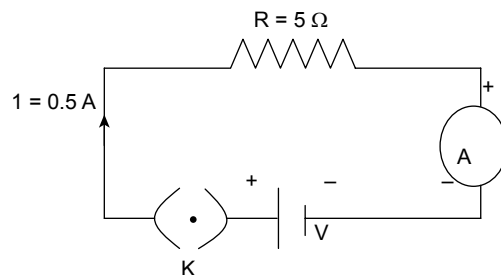
31. The heat generated in a coil of resistance $180\ \Omega$ which is connected to a silver voltameter is 364.5 kJ. If a steady current is passed through the circuit for 15 min, find the mass of Ag that gets deposited on the cathode. The relative atomic mass of silver is 108 g and Faraday's constant is 96,500 C.

(1) 15 g (2) 1.5 g
(3) 150 g (4) 0.015 g

32. To operate an electric heater of resistance $150\ \Omega$ and a copper voltameter simultaneously, a clever student connected them in series as there was only one plug available in a room. If a steady current is passed through the circuit for 20 minutes and if 0.05 g of Cu gets deposited on the cathode, calculate the heat generated in the coil in joule (e.c.e. of Cu = $3.3 \times 10^{-7}\ \text{kg C}^{-1}$).

(1) 2870 J (2) 3625 J
(3) 1250 J (4) 5740 J

33. Study the following circuit diagram. Find the potential difference provided by the cell.



(1) 2.5 V (2) 250 V
(3) 25 V (4) 6 V

34. Find the effective resistance, when $1\ \Omega$, $10\ \Omega$ and $4\ \Omega$ resistances are connected in series.

(1) $25\ \Omega$ (2) $15\ \Omega$
(3) $30\ \Omega$ (4) $\frac{20}{27}\ \Omega$

35. The resistance of 1 m of nichrome wire is $6\ \Omega$. Calculate its resistance if its length is 70 cm.

(1) $4.2\ \Omega$ (2) $8.4\ \Omega$
(3) $3.6\ \Omega$ (4) $6.3\ \Omega$

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

- Consider two bodies A and B of same capacitance. If charge of $-10\ \text{C}$ flows from body A to body B, then
 - the potential of body A increases.
 - the potential of body B decreases.
 - the magnitude of change in potential in both bodies is same.
 - All the above
- If the charge on two point charged bodies and the medium surrounding them are kept unchanged and the distance between them is reduced by 50%, then the force between them _____.
 - is doubled
 - is quadrupled

(3) becomes half
(4) decreases to 1/4th of their original force

3. The electric field strength at a point in an electric field is $30\ \text{N C}^{-1}$. Find the force experienced by a charge of $20\ \text{C}$ placed at the point.

(1) 300 N
(2) 600 N
(3) 200 N
(4) 100 N

4. A charge of $10\ \text{C}$ is brought from infinity to a point near a charged body and in this process, 200 J of work is done. Calculate the electric potential at that point near the charged body.

(1) 20 V (2) 10 V
(3) 5 V (4) 15 V

5. A charge of 5 C is moved between two points in an electric field and 20 J of work was done to do so. Calculate the potential difference between the two points.
 - (1) 4 V
 - (2) 2 V
 - (3) 3 V
 - (4) 6 V
6. Calculate the work done to move a $10 \mu\text{C}$ charge from a point at a potential of 10 V to a point which is at a potential 90 V.
 - (1) 8×10^{-4} J
 - (2) 80 J
 - (3) 18×10^{-4} J
 - (4) 8×10^{-3} J
7. Two identical spheres, one positively charged and the other negatively charged are held d cm apart. If the magnitude of the charges on the two spheres are equal, find the electric potential at a point midway on the line joining the centres of the two spheres.
 - (1) Zero
 - (2) 10 V
 - (3) 5 V
 - (4) 1.6×10^{-19} V
8. The acceleration of an electron placed in an electric field of strength $18.2 \times 10^{-6} \text{ N C}^{-1}$ is _____ ms^{-2} .
 - (1) 1.6×10^6
 - (2) 3.2×10^6
 - (3) 6.4×10^6
 - (4) 1.2×10^4
9. The ratio of resistances of two resistors A and B connected in series is 1 : 4 and the current passing through them is 10 A. Then the ratio of current that flows through them when connected in parallel and connected across the same pd is _____.
 - (1) 4 : 1
 - (2) 1 : 4
 - (3) 1 : 2
 - (4) 2 : 1
10. A cell of emf 5 V can supply a total energy of 9000 J, then the total charge that can be obtained from the cell would be ____ C.
 - (1) 180
 - (2) 18000
 - (3) 1800
 - (4) 18
11. A unit positive charge is moved along the circumference of a circle due to the attraction of a -100 C charge at the centre of the circle. Then the work done in the process is _____.
 - (1) negative work of 100 J
 - (2) positive work of 100 J
 - (3) zero
 - (4) $\frac{Q.1}{4\pi \epsilon_0 .r}$
12. If two resistors of resistance 30Ω and 40Ω are connected in parallel across a battery. The ratio of potential difference across them is _____.
 - (1) 1 : 1
 - (2) 2 : 1
 - (3) 3 : 4
 - (4) 4 : 3
13. Power of an electric heater is 1000 W and it is run for 1 hour. Calculate the energy consumed by it.
 - (1) 3.6 MJ
 - (2) 1.2 MJ
 - (3) 1.8 MJ
 - (4) 4.2 MJ
14. Calculate the units of electricity consumed in the month of November from the following details. One 60 W bulb used for 5 hours daily.
One 100 W bulb is used for 3 hours daily.
One 1 kW electric heater is used for 2 hour daily.
 - (1) 78
 - (2) 14
 - (3) 36
 - (4) 18
15. Calculate the resistance offered by 3 HP water pump which runs on 220 V supply.
 - (1) 21.63Ω
 - (2) 42.6Ω
 - (3) 63.2Ω
 - (4) 37.6Ω
16. Vinay was given a circle constructed of a uniform wire of resistance of 2 ohm per cm by his teacher. She asked him to connect it in a circuit such that it offers maximum resistance. Find the maximum resistance. (Take radius of the circle as 7 cm).
 - (1) 44Ω
 - (2) 22Ω
 - (3) 88Ω
 - (4) 11Ω
17. The colour code of a resistor is brown, black and brown. Then the value of resistance is _____.
 - (1) 10Ω
 - (2) $100 \text{ m}\Omega$
 - (3) $0.1 \text{ k}\Omega$
 - (4) 1000Ω
18. Among identical spheres A and B having charges as -5 C and -16 C
 - (1) -5 C is at higher potential.
 - (2) -16 C is at higher potential.
 - (3) Both are at equal potential.
 - (4) It cannot be said.
19. Calculate the work done to move a charge 5 C between two points A and B, if both the points are maintained at same potential of 6 V.
 - (1) Zero
 - (2) 6 J
 - (3) 3 J
 - (4) 12 J

20. The lengths of two wires made of the same material are in the ratio 2 : 1. If the masses of the two wires are in the ratio 1 : 8, find the ratio of their resistances.

(1) 1 : 16 (2) 32 : 1
(3) 16 : 1 (4) 1 : 32

21. An electrician not aware of the colour coding of resistors connected two resistors A and B in series to a 6 V battery of internal resistance $3\ \Omega$ and an ammeter. The ammeter connected in the circuit was not working and hence he disconnected the ammeter from the circuit. The sequence of the colour bands on resistor A is yellow, violet and brown while that on resistor B is red, violet and black respectively. By using the colour coding of resistors, help the electrician to determine the current flowing through the circuit.

(1) 12 mA (2) 24 mA
(3) 48 mA (4) 32 mA

22. A student while performing an experiment was surprised to find that when two identical cells are either connected in series or in parallel across a $2\ \Omega$ resistor, the same current passes through the resistor. What is the internal resistance of each cell?

(1) $2\ \Omega$ (2) $4\ \Omega$
(3) $1\ \Omega$ (4) $3\ \Omega$

23. An electrical bulb is rated 40 W – 220 V, when it is connected to a 220 V source. Find the current drawn by the bulb.

(1) 0.1666 A (2) 0.1333 A
(3) 0.1623 A (4) 0.1818 A

24. Aneesh was performing an experiment with two bulbs rated as 60 W – 220 V and 100 W – 220 V. When he connected the two bulbs in series to a 440 V supply, one of the bulbs got fused. The amount of current flowing through the circuit is _____ A

(1) 0.1256 (2) 0.3409
(3) 0.27 (4) 0.72

25. The heat generated in a coil of resistance $250\ \Omega$ which is connected to a silver voltameter is 364.5 kJ. If a steady current is passed through the circuit for 30 min, find the mass of Ag that gets deposited on the cathode. The relative atomic mass of silver is 108 g and Faraday's constant is 96,500 C.

(1) 0.9 g (2) 1.8 g
(3) 2.7 g (4) 6.4 g

26. Two bulbs A and B are connected to a 220 V supply. The maximum current that can flow through A and B

is 0.5 A and 1.2 A respectively. The effective resistance of the two bulbs in series and parallel is $283.3\ \Omega$ and $58.6\ \Omega$ respectively. The current flowing through the circuit when they are connected in series is _____ A and in parallel is _____ A.

(1) 0.78, 3.7
(2) 2.4, 1.2
(3) 3.6, 8.6
(4) 0.2, 1.7

27. An electric heater of resistance $150\ \Omega$ and a copper voltameter connected in series. If a steady current is passed through the circuit for 40 minutes and if 0.05 g of Cu gets deposited on the cathode, calculate the heat generated in the coil in joule (e.c.e. of Cu = $3.3 \times 10^{-7}\ \text{kg C}^{-1}$).

(1) 1212 J (2) 3860 J
(3) 1435 J (4) 2870 J

28. When five resistors of equal resistances are in series their equivalent resistance is $10\ \Omega$. If the same resistors are joined in parallel, what is their equivalent resistance?

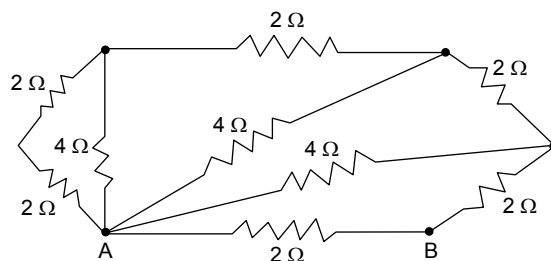
(1) $0.2\ \Omega$
(2) $0.4\ \Omega$
(3) $0.8\ \Omega$
(4) $1.6\ \Omega$

29. If 10×10^{19} electrons pass through the cross-section of a wire in 2 s, calculate the electric current flowing through the circuit.

(1) 8 A
(2) 16 A
(3) 20 A
(4) 2 A

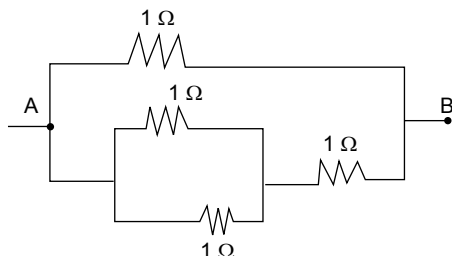
30. A careless student instead of connecting the resistors in parallel connected them as shown below.

Calculate the effective resistance between A and B.



(1) $4/3\ \Omega$ (2) $2/3\ \Omega$
(3) $3/2\ \Omega$ (4) $3/4\ \Omega$

31. Calculate the effective resistance between the points A and B for following circuit.



- (1) $\frac{3}{5} \Omega$ (2) $\frac{1}{3} \Omega$
(3) $\frac{2}{3} \Omega$ (4) $\frac{3}{2} \Omega$

32. What should be the bill for the month of April for a heater of resistance 60.5Ω connected to 220 V mains? The cost of energy is ₹2 per kWh and the heater is used for 3 hours daily.

- (1) ₹144 (2) ₹222
(3) ₹662 (4) ₹23.7

33. An electric bulb is connected to a 20 V battery of negligible internal resistance. The resistance offered

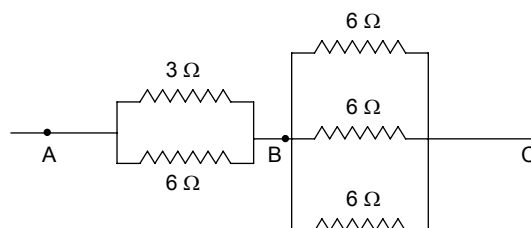
by the bulb is 5Ω . The electrical energy consumed by the bulb in 3 hours is _____ kWh.

- (1) 0.12 (2) 0.24
(3) 0.06 (4) 0.03

34. The resistance of an electric heater is 200Ω and it draws a current of 1 A. Calculate the power consumed by it and the potential difference across its ends.

- (1) 100 W, 100 V (2) 100 W, 200 V
(3) 200 W, 100 V (4) 200 W, 200 V

35. For the given circuit, find the effective resistance between A and C.



- (1) 2Ω (2) 4Ω
(3) 6Ω (4) 3Ω

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 1 | 4. 2 | 5. 4 | 6. 3 | 7. 3 | 8. 1 | 9. 2 | 10. 3 |
| 11. 1 | 12. 1 | 13. 1 | 14. 2 | 15. 4 | 16. 2 | 17. 4 | 18. 2 | 19. 2 | 20. 1 |
| 21. 4 | 22. 2 | 23. 4 | 24. 1 | 25. 4 | 26. 3 | 27. 3 | 28. 1 | 29. 3 | 30. 1 |
| 31. 2 | 32. 1 | 33. 1 | 34. 2 | 35. 1 | | | | | |

PRACTICE EXERCISE 5 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 2 | 4. 1 | 5. 1 | 6. 1 | 7. 1 | 8. 2 | 9. 1 | 10. 3 |
| 11. 3 | 12. 1 | 13. 1 | 14. 1 | 15. 1 | 16. 2 | 17. 3 | 18. 1 | 19. 1 | 20. 2 |
| 21. 1 | 22. 1 | 23. 4 | 24. 2 | 25. 2 | 26. 1 | 27. 3 | 28. 2 | 29. 1 | 30. 1 |
| 31. 1 | 32. 1 | 33. 2 | 34. 4 | 35. 2 | | | | | |

Electromagnetism

SYNOPSIS

- A magnet attracts magnetic materials. The magnetic force of attraction is maximum in small regions near the ends of the magnet. These are called the poles of the magnet.
- A freely suspended magnet always points in north-south direction. The pole pointing towards north is called north pole. The other pole which points towards south is called south pole. Like poles repel and unlike poles attract.
- Magnetic poles always exist in pair.
- Magnetic compass consists of a magnetic needle pivoted at its centre and encased in a brass box with a glass top. It is used to find 'directions'.
- The product of the pole strength (m) and the magnetic length (2ℓ) of a bar magnet is called magnetic moment (M). $M = m \times 2\ell$. Its unit is ampere-metre²
- The process in which a magnetic substance becomes a magnet when kept near a powerful magnet is called magnetic induction.
- The substances which are strongly attracted by a magnet are called ferromagnetic substances. These substances can be easily magnetized to make strong magnets.
- The substances which are feebly attracted by a magnet are called paramagnetic substances.
- The substances which are feebly repelled by a strong magnet are called diamagnetic substances.
- The ability of the pole of a magnet to attract or repel another magnetic pole is called its pole strength (m). Its SI unit is ampere-metre (A m).
- The force of attraction (F) or repulsion between two magnetic poles is directly proportional to the product of their pole strength (m) and inversely proportional to the square of the distance (r^2) between them and acts along the line joining the poles.

$$F = \frac{\mu}{4\pi} \frac{m_1 m_2}{r^2}$$
 where μ is the permeability of the medium.
- Magnetic permeability (μ) of a medium is defined as its ability to allow the magnetic lines of force to pass through it.

$$\mu = \mu_0 \mu_r$$
 where μ_r is the relative permeability and μ_0 is the permeability of vacuum or air.
- The space surrounding a magnet within which the magnetic effect is felt is called a magnetic field.
- When a unit north pole is placed at a point in a magnetic field, the force experienced by it is called the intensity of the magnetic field at that point. The intensity of the magnetic field decreases with an increase in the distance of the point from the magnet.
- The path along which a free north pole moves in a magnetic field is called a line of force. They leave the

north pole and enter the south pole externally and from south pole to north pole within the magnet.

- The total number of magnetic lines of force passing through a given area is called magnetic flux 'ϕ'. Unit of magnetic flux is weber (Wb). Magnetic flux per unit area (A) is called magnetic flux density or magnetic induction (B). $B = \frac{\phi}{A}$
- Magnetic induction (B) can also be defined as the force experienced by a unit north pole kept in a magnetic field. Magnetic induction (B) at a point in a magnetic field is $B = \frac{\mu_0 m}{4\pi r^2}$. Its SI unit is Wb m^{-2} or tesla (T) and CGS unit is gauss (G), $1 \text{ T} = 10^4 \text{ G}$.
- Intensity of magnetic field (H) can be defined as the force acting on a unit north pole independent of the medium. $H = \frac{m}{4\pi r^2}$. Its SI unit is ampere metre^{-1} (A m^{-1}), in CGS system, its unit is oersted.
- Intensity of magnetic field (H) and magnetic flux density (B) are related as $B = \mu_0 H$.
- Magnetic moment (M) of a bar magnet is given by the product of its length (2ℓ) and pole strength (m). $M = (2\ell) \times m$. Its unit is A m^2 .
- The magnetic field induction (B) of a bar magnet on the axial line is given by $B = \frac{\mu_0}{4\pi} \frac{2M}{d^3}$, d is the distance of the null point from the centre of the magnet. Its unit is $\text{N A}^{-1} \text{m}^{-1}$.
- Magnetic field induction 'B' of a magnet on the equatorial line is given by $B = \frac{\mu_0}{4\pi} \frac{M}{d^3} \text{ N A}^{-1} \text{m}^{-1}$.
- Magnetic susceptibility 'χ' is the measure of capability of a medium to get magnetized. Susceptibility of a substance is defined as the ratio of intensity of magnetization 'I' to the intensity of applied magnetic field (H). $\chi = I/H$, magnetic susceptibility is a constant for a given substance and has no unit.
- When current passes through a conductor magnetic field is created around it, this is known as electromagnetism.
- The direction of magnetic field due to a current carrying conductor can be found using right hand grip rule. Hold a linear conductor in your right hand. If the direction of pointing a thumb indicates the direction of current through the conductor, then the direction of the other fingers curled around the rod indicates the direction of the magnetic field produced by the current through the conductor.

- A coil made of an insulated conducting wire, wound around a cylindrical tube behaving like a magnet when an electric current flows through it is known as 'solenoid'.
- Solenoid with a soft iron core inside it can act as an electromagnet. It behaves like a magnet as long as current flows through it.
- Magnetic field induction 'B' due to a long straight current (i) carrying wire at a distance 'r' from the wire is $B = \frac{\mu_0 i}{2\pi r}$ where μ_0 is the permeability of vacuum.
- Magnetic field induction 'B' at the centre of a circular current carrying wire of 'n' turns is $B = \frac{\mu_0 i n}{2r}$
- When a current (i) carrying conductor of length (ℓ) is kept in a magnetic field (B) by making an angle θ with the direction of magnetic field, it experiences a force $F = B i \ell \sin\theta$
- The phenomenon in which an induced emf is produced in a coil due to a change in the current with respect to the time, $\left(\frac{di}{dt}\right)$ in the same coil is called self-induction, and the induced emf is called self induced emf (E). $E = -L \frac{di}{dt}$, where L is the self inductance of the coil.
- The phenomenon due to which a change in the current with respect to the time (di/dt) in a coil induces an emf in another coil held close to it is called 'mutual induction' and the induced emf (E), $E = -M \frac{di}{dt}$ where M is the mutual inductance.
- Transformer works on the principle of electromagnetic induction using mutual inductance of two coils. Transformer ratio secondary

$$= \frac{\text{Output voltage in secondary coil}}{\text{Input voltage in primary coil}}$$

$$= \frac{\text{Number of turns in secondary coil}}{\text{Number of turns in primary coil}}$$
- Earth behaves like a huge bar magnet with its south pole near its geographic north and vice versa.
- The geographic meridian at a given place is an imaginary plane containing the place and passing through the geographical north pole and the south pole and the magnetic meridian at a given place is an imaginary plane containing the place and passing through the magnetic north and the south poles.
- The angle of declination at a given place is the angle between the geographic meridian and the magnetic meridian.

- The angle through which north pole dips with respect to the horizontal is called the angle of dip. It is also defined as the angle between the resultant intensity of the earth's magnetic field (I) and horizontal component (H) at a given place.
- Null point is a point where the net magnetic field is zero.
- When south pole of a bar magnet points towards geographical north, two neutral points are formed on the axial line of the magnet.
- When north pole of a bar magnet pointing towards geographical north, null points are obtained on the equatorial line.

Solved Examples

1. Two magnetic poles of pole strength 2 A m and 3 A m respectively when separated by certain distance experiences 5 N force. When the pole strength of both the magnetic poles increased by half of their original pole strength without changing the distance between them, calculate the force of attraction between them.

Solution: $m_1 = 2 \text{ A m}$, $m_2 = 3 \text{ A m}$

$$F = 5 \text{ N} \Rightarrow 5 = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2 \times 3}{d^2} \rightarrow (1)$$

$$m_1^1 = 2 + 1 = 3 \text{ A m}; m_2^1 = 3 + 1.5 = 4.5 \text{ A m}$$

$$F_1 = \frac{\mu_0}{4\pi} \frac{m_1^1 \times m_2^1}{d^2}$$

$$F_1 = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{3 \times 4.5}{d^2} \rightarrow (2)$$

$$5 = \frac{10^{-7} \times 6}{d^2} \rightarrow (1)$$

$$F_1 = \frac{10^{-7} \times 13.5}{d^2} \rightarrow (2)$$

$$\frac{5}{F_1} = \frac{6 \times 10^{-7}}{d^2} \times \frac{d^2}{10^{-7} \times 13.5}$$

$$\frac{5}{F_1} = \frac{6}{13.5};$$

$$F_1 = \frac{13.5 \times 5}{6} = 11.25 \text{ N}$$

2. By taking the values of V and H at a given place as 40,000 nT and 16000 nT (approximately), where $1 \text{ nT} = 10^{-9} \text{ T}$, calculate the magnetic intensity I upto one place of decimal.

Solution: $I = \sqrt{H^2 + V^2}$

$$= \sqrt{(40000 \text{ nT})^2 + (16000 \text{ nT})^2}$$

$$= 10^4 \times \sqrt{4^2 + 1.6^2} \text{ nT} = \sqrt{16 + 2.56} \times 10^4 \text{ nT}$$

$$= \sqrt{18.56} \times 10^4 \text{ nT} = 4.3 \times 10^4 \text{ nT}.$$

3. The magnetic moment of a bar magnet is 2 A m². If the magnetic length of the bar magnet is 5 cm, determine the force acting on it in an external magnetic field of strength 0.6 T.

Solution: Magnetic moment $M = 2 \text{ A m}^2$; Magnetic length $2\ell = 5 \text{ cm} = 5 \times 10^{-2} \text{ m}$.

Magnetic field $B = 0.6 \text{ T}$

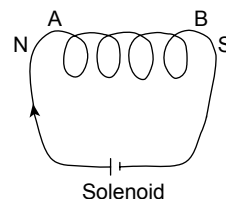
$$B = \frac{\text{force}}{\text{pole strength(m)}}; F = B \times m; M = m \times 2\ell$$

$$2 = m \times 5 \times 10^{-2}; m = \frac{2 \times 100}{5} = 40 \text{ A m}$$

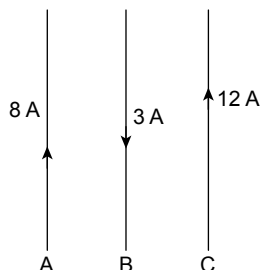
$$\therefore F = 0.6 \times 40 = 24 \text{ N}$$

4. Ranjith purchased a bar magnet to map the magnetic lines of force. When he cut the magnet into two pieces along its length, he found that the crowding of the magnetic lines of force is different. Explain why the crowding of magnetic lines of force is different.

Solution: When a magnet is cut along its length, the magnetic pole strength of each part is half of the pole strength of the original magnet. Hence the number of lines of force at the pole would be less.



5. Three straight current carrying conductors A, B and C are placed parallel next to each other by an electrician as shown in the figure. Then determine the direction of resultant force acting on the wire B.



☞ **Solution:** The wire B is repelled by both the wires A and C as they carry current in the opposite direction to that of B. However, as 'C' carries large current, it repels 'B' with greater force than 'A'. Hence 'B' moves towards A.

6. If a magnetic compass and a dip circle are taken to the magnetic poles of the earth, what would be the directions of their needles? Explain giving reasons.

☞ **Solution:** Needle of a compass shows random direction, whereas needle of a dip circle is oriented towards the direction of earth's magnetic field.

7. Two magnetic poles separated by a certain distance experiences a force of 10 N between them. Determine the force between them if the pole strength

of each pole is doubled and distance between them is reduced to half of the original distance.

☞ **Solution:** $F_1 = \frac{\mu}{4\pi} \frac{m_1 m_2}{d^2} = 10 \text{ N};$

$$F_2 = \frac{\mu}{4\pi} \times \frac{2m_1 \times 2m_2}{(d/2)^2} = \frac{\mu}{4\pi} \times \frac{m_1 m_2 \times 4 \times 4}{d^2}$$

$$= F_1 \times 4 \times 4 = 10 \times 16 = 160 \text{ N}$$

8. When a bar magnet is placed along the magnetic meridian such that its north pole is pointed towards the geographical south, a null point is obtained at a distance of 10 cm from the bar magnet. Determine the magnetic moment of the bar magnet. The horizontal component of earth's magnetic field at that place is $0.39 \times 10^{-4} \text{ T}$.

☞ **Solution:** The null points are obtained on the axial line when the north pole faces the geographical south pole. At the null point, horizontal component of earth's magnetic field

$(B_H) =$ the magnetic field due to the bar magnet.

$$\text{Therefore, } B = \frac{\mu_0}{4\pi} \times \frac{2M}{d^3} = B_H;$$

$$\frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2M}{(0.1)^3} = 0.39 \times 10^{-4}$$

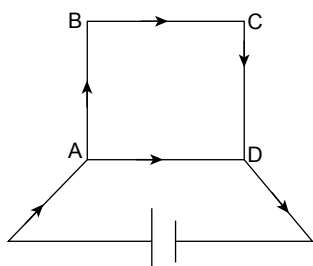
$$M = \frac{0.39 \times 10^{-4} \times 10^{-3}}{2 \times 10^{-7}} = 0.195 \text{ A m}^2$$

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. The space surrounding a magnet within which the magnetic effect is felt is called
 - (1) magnetic field.
 - (2) intensity of magnetic field.
 - (3) magnetic meridian.
 - (4) None of these
2. What is the angle of dip when both vertical and horizontal components of the earth's magnetic field are equal?
 - (1) 30°
 - (2) 45°
 - (3) 60°
 - (4) 90°
3. A conductor carrying current from south to north deflects the magnetic needle placed parallel and above it towards _____.
 - (1) east
 - (2) west
 - (3) north
 - (4) south
4. The magnetic field near the centre of a current carrying coil is uniform and _____.
 - (1) parallel to the plane of coil
 - (2) perpendicular to the plane of coil
 - (3) circular
 - (4) Both (2) and (3)
5. The angle of dip increases as we move from
 - (1) poles to equator.
 - (2) equator to poles.
 - (3) Dip is equal at all places.
 - (4) None of these
6. A solenoid is _____.
 - (1) an electromagnet
 - (2) a temporary magnet
 - (3) a permanent magnet
 - (4) Both (1) and (2)
7. A solenoid with a soft iron core is called a _____.
 - (1) electromagnet
 - (2) magnet
 - (3) conductor
 - (4) insulator
8. In a DC electric motor, a pair of _____ is used as a commutator.
 - (1) split rings
 - (2) sliprings
 - (3) plug key
 - (4) tap key
9. Sita, a student of 10th class demonstrates an experiment with help of a cell and connecting wires of uniform area of cross section. She made a closed square loop ABCD with the connecting wires and connected across a cell as shown in the figure. She found the ratio of magnetic-fields at the centre produced by side AD to that of side BC as _____.
 - (1) 2 : 1
 - (2) 1 : 1
 - (3) 3 : 1
 - (4) 1 : 2
10. Calculate the magnetic field induction 'B' at the centre of a circular coil having 500 turns, radius π cm and carrying 5 A of current.
 - (1) 0.1 T
 - (2) 0.005 T
 - (3) 0.5 T
 - (4) 0.05 T
11. A pole of strength 150 A m is placed axially at a distance of 10 cm from a short bar magnet of dipole moment 20 A m². The force experienced by it is _____.
 - (1) 0.2 N
 - (2) 0.4 N
 - (3) 0.6 N
 - (4) 0.8 N
12. When two magnetic poles having same pole strength are separated by a distance of 20 cm, a force of 5 N acts between them. If the distance is halved, the force becomes _____.
 - (1) 20 N
 - (2) 10 N
 - (3) 15 N
 - (4) 25 N
13. Which of the following is minimum at the poles?
 - (1) Angle of dip.
 - (2) Horizontal component of the earth's magnetic field.
 - (3) Angle of declination.
 - (4) Vertical component of the earth's magnetic field.
14. A bar magnet of dipole moment 'M' is initially parallel to a magnetic field of induction B. The angle through which it should be rotated so that the torque acting on it is half the maximum torque is _____.
 - (1) 90°
 - (2) 60°
 - (3) 45°
 - (4) 30°

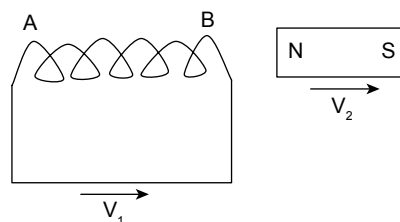
15. Among the following _____ has the highest retentivity.
- (1) aluminium
 - (2) steel
 - (3) nickel
 - (4) soft iron
16. An emf is induced in an aeroplane during its ascent and descent in east-west direction due to
- (1) the horizontal component of the earth's magnetic field.
 - (2) the vertical component of the earth's magnetic field.
 - (3) Both (1) and (2)
 - (4) None of the above
17. A current of 8 A flows through a horizontal wire from east to west. If the horizontal component of the earth's magnetic field is 4×10^{-5} T, then the neutral point is _____
- (1) not formed.
 - (2) formed at 0.08 m south of the wire.
 - (3) formed at 0.06 m above the wire.
 - (4) formed at 0.04 m below the wire.
18. In a straight conductor carrying current, if the current is tripled and the distance of the point from the conductor is doubled, then the ratio of magnetic inductions is _____.



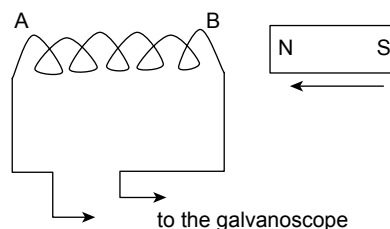
- (1) 3 : 2
 - (2) 2 : 3
 - (3) 4 : 9
 - (4) 9 : 4
19. A cycle dynamo works on the principle of _____.
- (1) chemical effects of current
 - (2) magnetic effects of current
 - (3) electromagnetic induction
 - (4) mechanical effects of current
20. When an electric current passes through a solenoid, the distance between any two adjacent rings of the solenoid _____.
- (1) decreases
 - (2) increases

- (3) does not change
- (4) first increases and then decreases

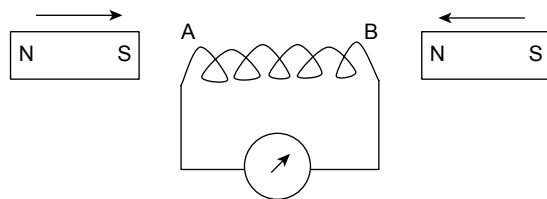
21. The amount of deflection of the magnetic needle in a galvanoscope depends on
- (1) the amount of current passing through the insulated copper wire that is wound over it.
 - (2) magnetic strength of the magnetic needle.
 - (3) number of turns of the coil.
 - (4) All the above
22. A conducting coil and a bar magnet move in the same direction along a straight line as shown in the figure. If the velocity of coil is more than the velocity of the bar magnet, then which of the following statements is true?



- (1) There is no change in magnetic flux linked with the coil.
 - (2) A magnetic south pole is formed at the end B of the coil.
 - (3) A magnetic north pole is formed at the end B of the coil.
 - (4) There is no induced emf in the coil.
23. The input A.C. voltage to the transformer is 3 kV and output is 100 V. Then
- (1) the ratio of number of turns in the primary to secondary coil is 30 : 1
 - (2) the transformer is a step-down transformer.
 - (3) the transformer is a step-up transformer.
 - (4) Both (1) and (2)
24. The deflection of the magnetic needle in the galvanoscope connected to the stationary circular coil AB (see figure) increases if

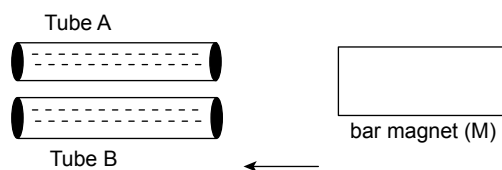


- (1) the strength of the magnet is decreased.
 (2) the velocity of the magnet is increased.
 (3) the number of turns in the coil is increased.
 (4) Both (2) and (3)
25. For a given transformer, the ratio of number of turns in primary and secondary coils is 1 : 7. If the input voltage and current are 50 V and 5 A respectively then the value of output current is _____ A.
 (1) 0.71
 (2) 0.97
 (3) 35
 (4) 9
26. Choose the correct statement from the following.
 (A) The strength of a solenoid can be increased by increasing the number of turns
 (B) The magnetic field due to a solenoid is similar to the magnetic field produced by a bar magnet.
 (1) Only A is true
 (2) Only B is true
 (3) Both A and B are true
 (4) Both A and B are false
27. An electron at rest gives rise to only _____.
 (1) magnetic field
 (2) electric field
 (3) Both electric and magnetic field
 (4) neither electric field nor magnetic field
28. Two magnetic needles, which can rotate in a vertical plane, are placed on either side of a straight current carrying conductor placed horizontally. Then
 (1) the two magnetic needles point upwards.
 (2) the two magnetic needles point downwards.
 (3) one magnetic needle points upwards and other points downwards.
 (4) two magnetic needles point towards the wire.
29. In an atom, electrons revolve around the nucleus. This gives rise to
 (1) only electric field.
 (2) only magnetic field.
 (3) both electric and magnetic fields.
 (4) None of the above
30. Two identical bar magnets move towards a stationary coil as shown in the figure with the same velocity. If windings of the coil at point A is clockwise then the true statement is



- (1) the end A of the coil becomes magnetic S-pole.
 (2) the end B of the coil becomes magnetic N-pole.
 (3) the current flows from A to B ends in the coil.
 (4) All the above
31. Match the following:
- | | |
|-----|--|
| (A) | (1) A magnetic substance with no magnetism |
| (B) | (2) partially magnetized magnet |
| (C) | (3) substance saturated with magnetism |
- (1) A - 1, B - 2, C - 3
 (2) A - 3, B - 1, C - 2
 (3) A - 2, B - 3, C - 1
 (4) A - 3, B - 3, C - 1
32. (A) While magnetizing a substance we force all molecular magnets to align in a specific direction.
 (B) In demagnetization, we disturb the regular alignment and force molecular magnets to orient randomly.
 (1) Both A and B are true.
 (2) Both A and B are false.
 (3) A is true but B is false.
 (4) A is false but B is true.
33. Magnetic equator is _____.
 (1) isoclinic line
 (2) aclinic line
 (3) isogonic line
 (4) agonic line
34. When a bar magnet is placed in earth's magnetic field, neutral points are obtained. At neutral point
 (1) net magnetic field is zero.
 (2) earth's magnetic field is not present.
 (3) magnetic field due to bar magnet is not present.
 (4) horizontal component of earth's magnetic field and magnetic field due to bar magnet are present and they are equal in magnitude and opposite in direction.

35.



In the above figure, tube A contains copper fillings and tube B contains aluminium fillings. If a strong

magnet is brought close to the two tubes as shown in the figure, then

- (A) centre of gravity of the tube A move towards right
- (B) centre of gravity of tube B move towards right.
- (1) Only A is true.
- (2) Only B is true.
- (3) Both A and B are true.
- (4) Neither A nor B is true.

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. The resultant intensity I of the earth's magnetic field can be resolved into two components, viz horizontal component H and vertical component V . Which of the following statements is false of a place closer to the north pole?

- (1) $V > H$.
- (2) V is nearly equal to I .
- (3) H is nearly equal to I .
- (4) $V = \sqrt{I^2 - H^2}$

2. Given below are two statements. Which of the statements is/are true?

Statement A: When the south pole of a magnet points towards the geographic north pole, the null points are along the equatorial line.

Statement B: At the null point, the earth's magnetic field is zero.

- (1) A is true, B is false.
- (2) Both A and B are false.
- (3) A is false, B is true.
- (4) Both A and B are true.

3. Consider the following two statements A and B, and select the correct choice.

A: Repulsion is a sure test of magnetism.
B: Magnetic induction precedes attraction.

- (1) Only A is true
- (2) Only B is true
- (3) Both are true
- (4) Both are false

4. Which of the following statements is true?

- (1) Magnetic equator is also called aclinic line.
- (2) On an agonic line, the angle of declination is zero.
- (3) Two places on an isoclinic line have the same angle of inclination.
- (4) All the above

5. If m is the pole strength, A is the area of cross section and I is the intensity of magnetization of a given magnet, prove that $I = \frac{m}{A}$.

- (1) $I = mA$
- (2) $I = \frac{m}{A}$
- (3) $I + m = A$
- (4) $m - A = I$

6. In a science fair, a student performed an activity with a magnet. First, he placed the magnet with its south pole pointing towards the geographic north of the earth and rotated the magnet by an angle of 180° , then calculated how the angle made by the line joining the neutral points had rotated. Find the angle.

- (1) 180°
- (2) 360°
- (3) 45°
- (4) 90°

7. A bar magnet of magnetic moment M is cut into 'p' parts along the axial line and 'q' parts perpendicular to the axial line. Find the magnetic moment of each piece.

- (1) M
- (2) $\frac{M}{pq}$
- (3) $\frac{M}{q}p$
- (4) $\frac{pq}{M}$

8. Magnetic induction due to a short bar magnet on its axial line at a distance 'd' is 'B'. Determine its magnetic induction value at the same distance on the equatorial line.
 (1) B (2) 2B
 (3) Bd (4) B/2
9. Which of the following statements is incorrect? In the process of electromagnetic induction, the magnitude of the induced emf depends on _____.
 (1) the number of turns of the coil
 (2) the magnetic flux linked with the coil
 (3) the rate of change of magnetic flux linked with the coil
 (4) area of the coil
10. In an AC generator, the rate of change of magnetic flux through the coil is maximum when the angle between the plane of the coil and the lines of force is
 (1) 0° (2) 60°
 (3) 30° (4) 90°
11. When a coil of 100 turns and resistance $0.5\ \Omega$ is moved towards a stationary magnet, the magnetic flux linked with the coil changes from 5×10^{-2} weber to 0.15 weber. Find the charge flowing through the coil during its motion.
 (1) 80 C (2) 40 C
 (3) 20 C (4) 60 C
12. Lenz's law is in accordance with the _____.
 (1) law of conservation of momentum
 (2) law of conservation of energy
 (3) law of conservation of mass
 (4) both (1) and (2)
13. The transformer turns ratio is 1 : 5 and 0.4 A current flows through the secondary when power developed across it is 200 W. Calculate primary and secondary voltage.
 (1) 2000 V (2) 1500 V
 (3) 1000 V (4) 500 V
14. A transformer
 (1) converts AC to DC.
 (2) converts DC to AC.
 (3) increases or decreases (step up or step down) AC voltage.
 (4) increases or decreases (step up or step down) DC voltage.
15. Two circular coils are made up of identical wires of length 30 cm. The number of turns in one coil is 5 and the number of turns in the other is 10. The ratio of magnetic induction at the centre of each coil when the same current flows through them is _____.
 (1) 2 : 1 (2) 1 : 2
 (3) 4 : 1 (4) 1 : 4
16. A coil having 100 turns is kept in a uniform magnetic field of induction 0.5 T. If its area changes from 0.3 m^2 to 0.1 m^2 in 10 s, then the emf induced is _____ V.
 (1) 2 (2) 1
 (3) 4 (4) 3
17. A feature common to both AC and DC generator is _____.
 (1) split rings
 (2) electrical energy is converted to mechanical energy
 (3) slip rings
 (4) mechanical energy is converted to electrical energy
18. In self induction
 (A) when current in a coil is increasing, induced emf opposes it.
 (B) when current in a coil is decreasing, induced emf supports it.
 (1) A is true, B is false.
 (2) A and B are false.
 (3) A and B are true.
 (4) A is false, B is true.
19. The mutual inductance between two coils when a current of 5 A changes to 10 A in 1 s and induces an emf of 100 mV in the secondary is _____.
 (1) 20 mH (2) 10 mH
 (3) 30 mH (4) 15 mH
20. A step up transformer converts 100 V at primary to 300 V at secondary. If the primary current is 6 A, then the secondary current is _____ A.
 (1) 4 (2) 8
 (3) 2 (4) 10
21. The south pole of a short magnet faces the geographical south. The neutral point is formed 4 cm from the centre of the magnet. The horizontal component of the earth's magnetic field is 5×10^{-5} T. The dipole moment of magnet is _____ A m^2 .
 (1) 1.6 (2) 3.2
 (3) 8 (4) 2

22. Two circular coils made up of identical wires of length 40 cm have respectively 8 and 4 turns and the current flowing through the second coil is 4 times greater than in the first coil. The ratio of magnetic induction at their centres is _____.
 (1) 2 : 3 (2) 3 : 2
 (3) 1 : 1 (4) 1 : 2
23. The force experienced by a pole of strength 200 A m placed along a perpendicular bisector, 20 cm away from the centre of a bar magnet of length 5 cm and pole strength 300 A m is _____ N.
 (1) 350×10^{-9} (2) 375×10^{-4}
 (3) 400×10^{-4} (4) 325×10^{-4}
24. The product of pole strengths of two magnetic poles separated by a distance is $100 \text{ A}^2 \text{ m}^2$ and the force between them is 20 N. Find the force if the poles are replaced by another pair of poles whose product of the pole strengths is $320 \text{ A}^2 \text{ m}^2$ and are maintained at the same distance.
 (1) 12 N (2) 48 N
 (3) 52 N (4) 64 N
25. A bar magnet of dipole moment M is initially perpendicular to a magnetic field of intensity B . The angle by which the magnet should be rotated so that the torque acting on it is half the maximum torque is _____.
 (1) 30° (2) 45°
 (3) 60° (4) 90°
26. Which of the following is minimum at the equator?
 (1) Angle of dip.
 (2) Horizontal component of earth's magnetic field.
 (3) Angle of declination.
 (4) Intensity of the earth's field.
27. Among the following _____ has highest susceptibility.
 (1) soft iron (2) steel
 (3) aluminum (4) nickel
28. An emf is induced in an axle of a moving train, due to _____.
 (1) the horizontal component of the earth's magnetic field.
 (2) the vertical component of the earth's magnetic field.
 (3) Both (1) and (2)
 (4) None of the above
29. A horizontal wire placed along north-south direction carries a current of 10 A. The neutral points are _____ if the earth's horizontal component is $5 \times 10^{-5} \text{ T}$.
 (1) not formed. (2) 0.08 m east of wire.
 (3) 0.07 m west of wire. (4) 0.05 m above wire.
30. The magnetic induction at a point near a current carrying conductor is doubled when current through it is changed and the point is shifted so that its distance is $2/3^{\text{rd}}$ of the original distance. The ratio of the currents is _____.
 (1) 2 : 1 (2) 3 : 4
 (3) 1 : 2 (4) 4 : 3
31. Two circular coils made up of identical wires of length 40 cm have respectively 18 and 9 turns and the current flowing through the second coil is 4 times the current through the first coil. The ratio of magnetic induction at their centres is _____.
 (1) 2 : 3 (2) 3 : 2
 (3) 1 : 1 (4) 1 : 2
32. A coil having 200 turns each of area 0.2 m^2 is kept in a magnetic field whose induction changes from 0.8 T to 1.2 T in 2 s. The induced emf is _____ V.
 (1) 8 (2) 2
 (3) 12 (4) 20
33. If the speed of rotation of armature coil is increased in an AC generator
 (1) magnitude of current increases.
 (2) frequency of current increases.
 (3) Both (1) and (2)
 (4) magnitude of current increases, frequency decreases.
34. In mutual induction
 A : when current in one coil increases, induced current in neighbouring coil flows in the opposite direction.
 B : when current in one coil decreases, induced current in neighbouring coil flows in the opposite direction.
 (1) A is true, B is false (2) A and B are false
 (3) A and B are true (4) A is false, B is true
35. The current flowing through the primary coil of mutual inductance 8 H is reduced to zero in 10^{-3} s . As a result of which a $24 \times 10^3 \text{ V}$ is induced in the secondary. The initial current through the primary is _____ A.
 (1) 2 (2) 1
 (3) 4 (4) 3

ANSWER KEYS**PRACTICE EXERCISE 6 (A)**

1. 1	2. 2	3. 1	4. 2	5. 2	6. 4	7. 1	8. 1	9. 3	10. 4
11. 3	12. 1	13. 2	14. 4	15. 2	16. 1	17. 4	18. 2	19. 3	20. 1
21. 4	22. 3	23. 4	24. 4	25. 1	26. 3	27. 1	28. 3	29. 3	30. 4
31. 2	32. 1	33. 2	34. 4	35. 2					

PRACTICE EXERCISE 6 (B)

1. 3	2. 2	3. 3	4. 4	5. 2	6. 4	7. 2	8. 4	9. 2	10. 1
11. 3	12. 2	13. 4	14. 3	15. 4	16. 2	17. 4	18. 1	19. 1	20. 3
21. 2	22. 3	23. 2	24. 4	25. 3	26. 1	27. 1	28. 2	29. 1	30. 2
31. 3	32. 1	33. 3	34. 1	35. 4					

Hydrostatics

SYNOPSIS

- Thrust is defined as the force acting on a body normal (perpendicular) to its surfaces. Unit of thrust is dyne in C.G.S system and newton (N) in SI system.
- Pressure (P) = $\frac{\text{thrust}(F)}{\text{area}(A)}$. SI unit is Nm^{-2} or pascal (Pa). C.G.S. unit is dyne cm^{-2} . 1 bar = 10^5 Pa, it is a scalar quantity, dimensional formula is $\text{M L}^{-1} \text{T}^{-2}$.
- Pressure (P) due to a liquid of density 'd' and height 'h' is $P = h \rho g$, where 'g' is acceleration due to gravity.
- The pressure exerted by a fluid is known as 'fluid pressure', the pressure exerted by a fluid column of height 'h' and density 'ρ' is Pressure (P) = $h \rho g$.
- The pressure exerted by the atmospheric gases on its surroundings and on the surface of the earth is known as the atmospheric pressure. Barometers are used for measuring the atmospheric pressure. 1 atmospheric pressure is equal to the pressure exerted by 76 cm of Hg column.
- A manometer is a device which is used to measure the pressure of a gas, in a closed enclosure.
- The Boyle's law states that at a constant temperature, the volume of a given mass of a gas is inversely proportional to its pressure.
 $P \propto 1/V$ or $PV = \text{constant}$.

- The Pascal's law states that an increase in pressure at any point inside a liquid at rest, is transmitted equally and without any change, in all directions to every other point in the liquid.
- The mechanical advantage (MA) of hydraulic press or Bramah press is

$$\begin{aligned} \text{MA} &= \frac{\text{area of cross section of press cylinder}}{\text{area of cross section of pump cylinder}} \\ &= \frac{\text{square of the radius of press cylinder } (R^2)}{\text{square of the radius of pump cylinder } (r^2)} \end{aligned}$$

- The Archimedes' principle states that when a body is partially or completely immersed in a fluid at rest, it experiences an upthrust which is equal to the weight of the fluid displaced by it. Due to the upthrust acting on the body, it apparently loses a part of its weight and the apparent loss of weight is equal to the upthrust.
- Relative density (R.D) = $\frac{\text{Density of substance}}{\text{Density of water at } 4^\circ \text{C}}$

$$= \frac{\text{Weight of the solid in air}}{\text{Apparent loss of weight of the body in water}}$$
- The laws of floatation:
 - (a) The weight of a body in air is equal to the weight of the fluid displaced by the body when it is floating in the fluid.

- (b) When a body is floating, the centre of gravity of the floating body and the centre of buoyancy are in the same vertical line.
- The hydrometer is an instrument used to measure the density of liquids directly. It works on the basis of laws of floatation.
 - Surface tension is the property of a liquid by virtue of which it behaves like a stretched elastic membrane so as to occupy minimum surface area.
 - The forces of friction which set up between various layers of liquid and which oppose the relative motion between them are called viscous forces. Viscosity of a liquid decreases as its temperature increases.
 - The phenomenon of rise or fall of a liquid in a capillary tube when it is dipped in a liquid is known as capillarity. Capillarity occurs due to surface tension of the liquid and the cohesive and adhesive forces.
 - The relative density of a solid soluble in water

$$= \frac{\text{Weight of solid in air} \times \text{relative density of the liquid}}{\text{Apparent loss of weight of the body in a liquid}}$$
 - The relative density of a liquid

$$= \frac{\text{Apparent loss of weight of a body in a liquid}}{\text{Apparent loss of weight of the same body in water}}$$
 - The characteristics of a floating body.
The weight of a floating body = Upthrust or a buoyant force = The apparent loss of weight of the body in the fluid.
 - The relative density of a body floating in water = fraction of volume of the body inside water.
 - A body sinks in a liquid if its density is greater than that of the liquid. If the density of a body is equal to the density of liquid then the body remains at rest in the same position wherever it is placed inside the liquid. A body floats in a liquid if its density is less than that of the liquid

Solved Examples

1. A rectangular plate $10 \text{ cm} \times 5 \text{ cm}$ is placed horizontally below the water surface in a trough at a depth of 2 m. If the atmospheric pressure is $1.013 \times 10^5 \text{ N m}^{-2}$, calculate the total thrust on the plate. (Given $g = 10 \text{ ms}^{-2}$)

✍ **Solution:** Pressure at a point 2 m below the water surface = atmospheric pressure + pressure due to the water column of height 2 m.

$$\text{Pressure due to water} = h \rho g$$

$$= 2 \text{ m} \times 10^3 \text{ kg m}^{-3} \times 10 \text{ ms}^{-2} = 0.2 \times 10^5 \text{ N m}^{-2}$$

$$\text{Total pressure} = (1.013 \times 10^5 + 0.2 \times 10^5) \text{ N m}^{-2} = 1.213 \times 10^5 \text{ N m}^{-2}$$

$$\text{Area of the plate} = 10 \text{ cm} \times 5 \text{ cm} = 50 \text{ cm}^2 = 50 \times 10^{-4} \text{ m}^2.$$

$$\text{Total thrust acting on the plate} = \text{total pressure} \times \text{area} = 1.213 \times 10^5 \times 50 \times 10^{-4} = 606.5 \text{ N}.$$

2. In a Hare's apparatus, the levels of the water in the tube and the beaker are 38.3 cm and 4.7 cm respectively. The specific gravity of liquid is 1.05 and its level in the tube is 35.5 cm. Find its level in the beaker.

✍ **Solution:** $a_1 = 38.3 \text{ cm}$; $a_2 = 4.7 \text{ cm}$; $h_1 = a_1 - a_2 = 38.3 - 4.7 = 33.6 \text{ cm}$; $b_1 = 35.5 \text{ cm}$; $b_2 = ?$

$$\text{R.D} = \frac{h_1}{h_2} = \frac{a_1 - a_2}{b_1 - b_2} \Rightarrow 1.05 = \frac{33.6}{35.5 - x}$$

$$\Rightarrow (35.5 - x) = \frac{33.6}{1.05} = 32; \therefore x = 35.5 - 32 = 3.5 \text{ cm}$$

3. A body weighs 250 g in air and 235 g when completely immersed in water. Calculate
(a) the apparent loss in weight of the body and
(b) buoyant force acting on it.

✍ **Solution:** Let W_1 = weight of the body in air = 250 gf.

$$W_2 = \text{weight of the body in water} = 235 \text{ gf}.$$

$$\text{Apparent loss in weight} = W_1 - W_2$$

$$= 250 \text{ gf} - 235 \text{ gf} = 15 \text{ gf}$$

The apparent loss in weight of a body is also equal to the upthrust acting on it. \therefore upthrust = 15 gf.

4. Level of water in the tube and beaker in the Hare's apparatus are 40.4 cm and 5.3 cm and corresponding levels of liquid are 35 cm and 5 cm. Find the specific gravity of the liquid.

✍ **Solution:** a_1 = level of water in the tube = 40.4 cm; a_2 = level of water in the beaker = 5.3 cm.
 $h_1 = a_1 - a_2 = 40.4 - 5.3 = 35.1 \text{ cm}$; b_1 = level of liquid in the tube = 35 cm.

b_2 = level of liquid in the beaker = 5 cm; $h_2 = b_1 - b_2$

$$= 35 - 5 = 30 \text{ cm. RD} = \frac{h_1}{h_2} = \frac{35.1}{30} = 1.17$$

5. The densities of water and ice are 1 g cm^{-3} and 0.917 g cm^{-3} . Find the fraction of an iceberg floating above the water surface and the fraction below it.

☞ **Solution:** Let V = the total volume of the iceberg.

V_1 = volume of the iceberg above the water surface.

$\therefore V - V_1$ = volume of the iceberg below the water surface.

By the law of floatation, weight of the iceberg = weight of the water displaced by the immersed part of the iceberg. $V \times 0.917 \times g = (V - V_1) \times 1 \times g$

$$V_1 = (1 - 0.917) V$$

$$V_1/V = 0.083/1 = 1/12 \text{ (approx)}$$

Thus $1/12$ th part of the total volume of the iceberg floats above the water surface.

$\therefore 11/12$ th part of iceberg is submerged in water.

6. A block of wood floats on water with $2/5$ of its volume above the surface. If it is made to float in brine solution of RD 1.20, what fraction of the wood is below the surface of the brine solution.

☞ **Solution:** Let V = Volume of the block, d = density of the block and density of the water = 1 g cm^{-3} .

$$\text{Volume of the block immersed} = V - \frac{2}{5}V = \frac{3}{5}V.$$

By the law of floatation, $Vdg = \frac{3}{5}V \times 1 \times g$;

$$\therefore d = 3/5 = 0.6 \text{ g cm}^{-3}$$

Density of the brine solution = 1.20 g cm^{-3} .

$$\therefore V \times 0.6 \text{ g cm}^{-3} = V_1 \times 1.20 \text{ g cm}^{-3}$$

$$V_1 = \frac{0.6}{1.20} V = 0.5 V,$$

Thus 50% of total volume of the wooden block is submerged in the brine solution.

7. The weight of a test tube float in water is 43 gwt and in a liquid is 44 gwt. If the depth of immersion of the float in both is same, find the specific gravity of the liquid.

☞ **Solution:** $W_1 = 43 \text{ gwt}$ = weight of the float for immersion in water. $W_2 = 44 \text{ gwt}$ = weight of the float for immersion to same level in liquid.

$$\text{RD of liquid} = W_2/W_1 = 44/43 = 1.023.$$

8. A cube of a metal whose density is 8.2 g cm^{-3} and side 7 cm is tied to a thread and completely immersed in a liquid of density 1.2 g cm^{-3} . Calculate the tension in the string.

☞ **Solution:** Tension in the string = net downward force acting on the cube.

$$\text{Volume of the cube} = 7 \text{ cm} \times 7 \text{ cm} \times 7 \text{ cm} = 343 \text{ cm}^3.$$

$$\text{Mass of the cube} = \text{Volume} \times \text{density} = 343 \text{ cm}^3 \times 8.2 \text{ g cm}^{-3} = 2812.6 \text{ g}; \text{ Weight of the cube} = 2812.6 \text{ gf.}$$

This weight acts in the downward direction.

Upthrust = Volume of cube \times density of liquid \times acceleration due to gravity.

$$= 343 \text{ cm}^3 \times 1.2 \text{ g cm}^{-3} \times g \text{ cm s}^{-2} = 411.6 \text{ gf}$$

$$\therefore \text{tension in the string} = 2812.6 - 411.6 = 2401 \text{ gf.}$$

9. The R.D of a liquid is 1.027 and a float of weight 38 gwt is allowed to float upto a certain depth in it. What additional weight should be added to the float if it is to float to the same depth in water as in liquid?

☞ **Solution:** Weight of the float $W_2 = 38 \text{ gwt}$. Relative density of the liquid = 1.027. Weight of the float when it floats to the same level in water = W_1 .

$$\text{RD} = \frac{W_2}{W_1} \Rightarrow 1.027 = \frac{38}{W_1} \Rightarrow W_1 = \frac{38}{1.027} = 37 \text{ gwt}$$

Since $W_1 < W_2$, additional weight need not be added to the float, but 1 gwt of mass has to be removed from the float.

10. A capillary tube having a bore of radius 0.5 mm is dipped vertically into a liquid. If the angle of contact between the liquid and capillary tube is 0° and density of liquid 1 g cm^{-3} and $g = 10 \text{ ms}^{-2}$ find the capillary rise in the tube. Take the surface tension of the liquid as 0.07 N m^{-1} .

☞ **Solution:** Given, radius of capillary tube, $r = 0.5 \text{ mm} = 0.5 \times 10^{-3} \text{ m}$.

angle of contact between the liquid and capillary tube, $\theta = 0^\circ$

density of liquid, $d = 1 \text{ g cm}^{-3} = 1000 \text{ kg m}^{-3}$

surface tension of liquid, $T = 0.07 \text{ N m}^{-1}$

capillary rise $h = ?$; $g = 10 \text{ ms}^{-2}$

$$\text{Capillary rise, } h = \frac{2T \cos \theta}{rdg}$$

$$= \frac{2 \times 0.07 \cos 0^\circ}{0.5 \times 10^{-3} \times 1000 \times 10} = h = 0.028 \text{ m}$$

PRACTICE EXERCISE 7 (A)

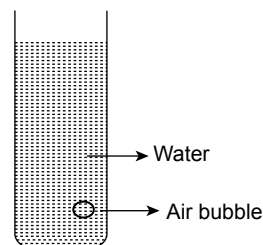
Directions for questions 1 to 35: Select the correct alternative from the given choices.

- The densities of two liquids are in the ratio of 1 : 3 and their volumes are in the ratio of 2 : 1. If the liquids are filled inside two identical containers, the ratio of pressure exerted by them at the bottom of the containers is _____.
 (1) 2 : 3 (2) 1 : 6
 (3) 4 : 3 (4) 2 : 1
- For a mechanical advantage of 9 the diameter of the press piston of a hydraulic lift must be _____ times the diameter of the pump piston.
 (1) 9 (2) 6
 (3) 3 (4) 12
- A barometer which measures atmospheric pressure more accurately is _____.
 (1) Fortin's barometer
 (2) mercury barometer
 (3) aneroid barometer
 (4) Torricelli barometer
- A pressure cooker is used at higher altitude since the atmospheric pressure at higher altitude is _____.
 (1) less than 76 cm of Hg
 (2) more than 76 cm of Hg
 (3) equal to 76 cm of Hg
 (4) depends upon the boiling point of water
- A liquid column exerts a pressure of 980 Pa on bottom surface of a container. Then determine the height of the liquid column in the container. (Take the density of liquid as 1000 kg m^{-3})
 (1) 98 cm (2) 9.8 cm
 (3) 980 cm (4) 0.098 cm
- A cube of a metal whose density is 8.2 g cm^{-3} and side 7 cm is tied to a thread and completely immersed in a liquid of density 1.2 g cm^{-3} . Calculate the tension in the string.
 (1) 2401 gf (2) 2401 N
 (3) 24 gwt (4) 3.4 N
- A flat bottomed test tube is used as variable immersion hydrometer, to measure the density of two liquids A and B. If h_A and h_B are the height of immersion

of the hydrometer in liquid A and liquid B respectively, then density of two given liquids 'A' and 'B' i.e.,

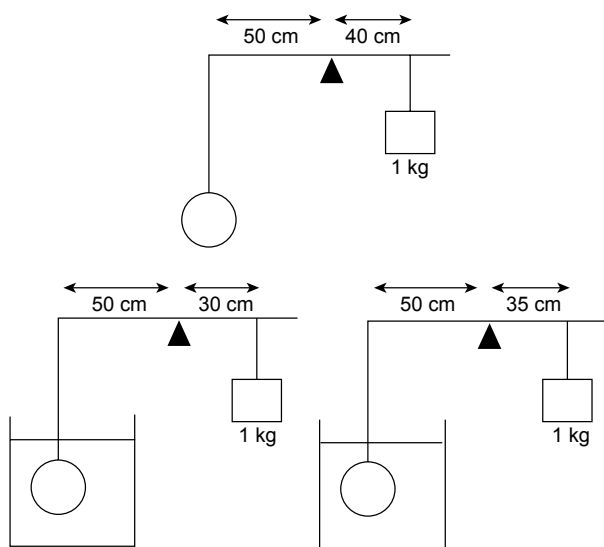
$\left(\frac{d_A}{d_B}\right)$ is equal to

- $\frac{h_B}{h_A}$
 - $\frac{h_A}{h_B}$
 - $h_B + h_A$
 - $\frac{h_B^2}{h_A^2}$
- A test tube of mass m floats upto mark X in water. When the same test tube is made to float upto mark 'X' in a given liquid, it requires some mass to be placed in the test tube. Then the density of the given liquid is
 (1) equal to the density of water.
 (2) less than the density of the water.
 (3) greater than the density of the water.
 (4) equal to the density of the test tube.
 - If a block of wood is floating in a river water, then the apparent weight of the floating block is
 (1) equal to the weight of the displaced water.
 (2) zero.
 (3) greater than the weight of the displaced water.
 (4) equal to the actual weight of the block.
 - Apparent loss of weight of a body when immersed in a liquid can be explained on the basis of
 (1) molecular theory.
 (2) electron theory.
 (3) Archimedes' principle.
 (4) Bernoulli's principle.
 - The air bubble inside the cylinder (from figure)



- moves towards the top surface of liquid in the cylinder.
- stays at the bottom of the cylinder.

- (3) makes horizontal oscillations in the cylinder.
 (4) Both (1) and (3)
12. A flat-bottomed test-tube with some lead shots in it floats upto a depth of 3.2 cm in a liquid and 2.4 cm in water. Find the relative density of the liquid.
- (1) 0.24 (2) 0.75
 (3) 0.1 (4) 0.5
13. Rahul took a wooden cube of volume 1000 cm^3 and put it in water. He observed that $\frac{3}{5}$ th of its volume is below the level of water. Later, he floated the cube in a liquid of density 0.8 g cm^{-3} and applied extra force on the cube to completely submerge it in the given liquid. Calculate how much extra force Rahul applied on the cube.
- (1) 2 N (2) 8 N
 (3) 6 N (4) 4 N
14. A metre scale is balanced on a sharp knife edge. A solid is suspended at one end of the scale and its position is fixed. A standard weight of 1 kg is used to balance the solid.



The positions of the standard weight to balance the given substance in air, water and a given liquid are 40 cm, 30 cm and 35 cm respectively, as shown in the figure. Find the relative density of the liquid.

- (1) 1 (2) 0.5
 (3) 0.75 (4) 0.25
15. A teacher gave an unknown liquid and solid spheres of relative densities 5 and 3.75 respectively to Raju and asked him to find out the density of the liquid with the help of two solid spheres. Raju first measured

the masses of the two spheres and found them to be 500 g and 750 g respectively. Then he took a uniform rod and suspended the two spheres to its ends such that both the spheres balance each other inside the liquid. Using this data, he successfully measured the density of the given liquid. The density of the given liquid is _____ kg m^{-3} .

- (1) 1500 (2) 3500
 (3) 1000 (4) 2500
16. An ice cube has a stone of 500 g placed on its top, is floating in water with its lateral sides placed vertically. It displaces 5 kg of water. Suddenly, the stone slips into water. Because of this ice cube rises by $\frac{1}{10}$ th of its length above the water level. What is the density of the ice cube?
- (1) 0.96 (2) 0.84
 (3) 0.90 (4) 0.82
17. An aeroplane wing has an area 50 m^2 . The speed of air flowing above the wing is 100 ms^{-1} and below the wing is 80 ms^{-1} . The aerodynamic lifting force acting on the aeroplane wing if density of air is 1.3 kg m^{-3} is _____ N.
- (1) 156×10^3 (2) 324×10^3
 (3) 256×10^3 (4) 117×10^3
18. A capillary tube when immersed in a liquid of density d , the capillary rise observed is h . When another capillary tube of 4 times cross sectional area as the first tube is immersed in another liquid of density $2d$, what is the observed capillary rise? Assume angle of contact of capillary tube with both liquids is 0° and the ratio of surface tensions of the two liquids is 1 : 2.
- (1) $h/2$ (2) h
 (3) $h/4$ (4) $h/3$
19. Ramesh took a hydrometer of 15 cm long stem. First when he immersed the hydrometer in water, the top edge of the stem just sinks. Then he took a liquid of density 1.8 g cm^{-3} and immersed the hydrometer in it and found that one-third of the stem is inside the liquid. He calculated the data and determined the maximum density of a liquid that can be measured using the hydrometer. Find the answer. (in g cm^{-3})
- (1) 3 (2) 2
 (3) 1 (4) 5
20. Calculate the height to which a water rises in a capillary tube of internal diameter 2 mm when capillary tube is dipped vertically in water. Surface tension of

water is 0.07 N m^{-1} and angle of contact between the water and glass is 0° and $g = 10 \text{ ms}^{-2}$.

- (1) 0.056 m (2) 0.032 m
(3) 0.025 m (4) 0.014 m

21. When water flows through a horizontal pipe the pressure and velocity of the water at one of the ends of the pipe is 600 Pa and 2 ms^{-1} respectively. What is the pressure at the other end if the velocity of the water coming out of it is 3 ms^{-1} ? (in pascal)

- (1) 1500 (2) 4200
(3) 3200 (4) 2100

22. Surface tension is explained on the basis of

- (1) molecular theory
(2) electron theory
(3) Archimedes principle
(4) Bernoulli's principle

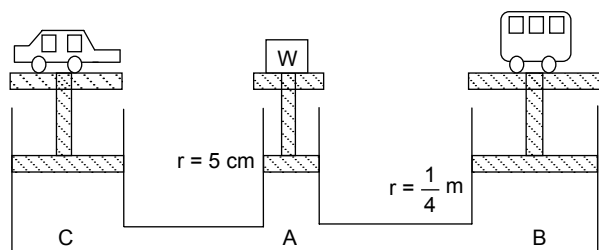
23. The length of water column that can exert 1 atm pressure is _____ m.

- (1) 1 (2) 10.3
(3) 13.6 (4) 26.2

24. A container is filled with water to a height of 10 m. The pressure exerted by the water at the bottom of the container is _____ Pa.

- (1) 9.8×10^4 (2) 980
(3) 980×10^5 (4) 19.6×10^4

25. The mechanical advantage of a hydraulic press is 5, the ratio of the distance travelled by the load to the effort is _____.



- (1) 1 : 3 (2) 1 : 5
(3) 1 : 4 (4) 1 : 25

26. The pressure exerted by a liquid column at the bottom of the container at a point inside a fluid

- (1) does not depend on the area of cross-section of container.
(2) dependent on the density of the fluid.
(3) equal in all directions.
(4) All the above are true

27. The radius of the press cylinder in a hydraulic press is equal to the diameter of its pump cylinder. Its mechanical advantage is _____.

- (1) 1 (2) 2
(3) 3 (4) 4

28. Which of the following is used to punch holes in thick metallic block?

- (1) Drilling machine (2) Hydraulic press
(3) Hammer and anvil (4) All the above

29. The mechanical advantage of a hydraulic press is 5. A car of mass 1500 kg is lifted by it when placed on a piston of a hydraulic press of area of cross section 5 m^2 . Find the area of cross-section of piston where the effort is applied.

- (1) 4 m^2 (2) 3 m^2
(3) 2 m^2 (4) 1 m^2

30. A simple barometer tube contains some air in it. The length of the tube above the mercury level in the trough is 80 cm . The height of mercury in the tube is 71 cm at normal atmospheric pressure. The actual decrease in the atmospheric pressure if the barometer reads 65 cm is _____ cm of Hg.

- (1) 5 (2) 6
(3) 9 (4) 8

31. In the figure shown, cylinder 'A' has pump piston, where as B and C cylinders have lift pistons. If the maximum weight that can be placed on the pump piston is 50 kgwt , what is the maximum weight that can be lifted by the piston in the cylinder 'B'. Find the total mechanical advantage.

(Take $g = 10 \text{ ms}^{-2}$)

- (1) 60 (2) 45
(3) 55 (4) 40

32. An ice cube's $\frac{1}{n}$ th portion sinks in water, then the density of ice is _____ g cm^{-3} .

- (1) $2n$ (2) $1/n$
(3) n (4) $n/2$

33. The centre of gravity and the centre of buoyancy of a floating body in a stable equilibrium

- (i) are always the same.
(ii) are always along a same vertical line.
(1) Only (i) is true.
(2) Only (ii) is true.
(3) Both (i) and (ii) are true.
(4) Both (i) and (ii) are false.

34. A liquid whose density is twice the density of mercury is used as a barometric liquid. Then one atmosphere pressure equals _____ cm of the liquid.
- (1) 76 (2) 38
(3) 152 (4) 380
35. Two metallic spheres of different materials immersed in water experience equal upthrust. Then both the spheres have equal
- (1) weights in air (2) densities
(3) volumes (4) masses

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- The diameter of the press (load) piston of a hydraulic lift is eight times the diameter of the pump (effort) piston. If a force 'F' newton is applied on the effort piston, then the maximum weight that can be lifted by press piston in terms of 'F' is _____.
(1) 16F (2) 50F
(3) 64F (4) 32F
- A water column exerts a pressure of 9800 Pa on bottom surface of a container. Then the height of the water column in the container is _____ m. ($g = 10 \text{ ms}^{-2}$)
(1) 0.49 (2) 0.98
(3) 0.62 (4) 9.8
- A cylindrical container is filled with water upto the brim. If the pressure exerted by the water at the bottom of the container is 1000 Pa the height of the container is _____ cm. (take $g = 10 \text{ ms}^{-2}$)
(1) 10 (2) 100
(3) 1 (4) 20
- The diameter of the press (load) piston of a hydraulic lift is 9 times the diameter of the pump (effort) piston. If a force 200 newton is applied on the effort piston, then determine the maximum weight that can be lifted by press piston in terms of 'F'.
(1) 64800 (2) 32400
(3) 8100 (4) 16200
- The RD of a liquid is 1.027 and a float of weight 38 gwt is allowed to float upto a certain depth in it. What weight should be removed from the float if it is to float to the same depth in water as in liquid?
(1) 1 gwt (2) 2 gwt
(3) 3 gwt (4) 4 gwt
- Two objects can displace 100 g and 200 g water when completely immersed in it. The ratio of their volumes is _____.
(1) 1 : 2 (2) 2 : 1
(3) 1 : 3 (4) 3 : 4
- A solid when immersed in water displaces $\frac{1}{2}$ litre of water. The same solid floats with $\frac{3}{4}$ of its volume below the surface of a given oil and displaces 800 g of oil. Then the relative density of body and oil is _____ and _____ respectively.
(1) 1.6, 2.13 (2) 1.3, 2.2
(3) 1.6, 1.9 (4) 2.1, 2.3
- A block of wood floats separately in river water and then in ocean water. Then the weight of the displaced river water is
(1) equal to the weight of the displaced ocean water.
(2) less than the weight of the displaced ocean water.
(3) more than the weight of the displaced ocean water.
(4) not dependent on the density of the wooden block.
- A balloon of volume 'v' and density 'd' is moving in upward direction in air. If the density of air is 'D', then the effective upward acceleration of the body is _____.
(1) $\frac{g(D-d)}{d}$ (2) $g\left(\frac{d-D}{d}\right)$
(3) $g\left(\frac{d-D}{D}\right)$ (4) $g\left(\frac{D-d}{D}\right)$
- _____ suggested that the ships should be marked with load lines.
(1) Samuel Plimsoll (2) Einstein
(3) Newton (4) Archimedes
- A common hydrometer has a long uniform stem. When floating in pure water, 4.5 cm of its stem lies below the surface of water. In a liquid of specific gravity 2.0, 1.5 cm of the stem of the same hydrometer is

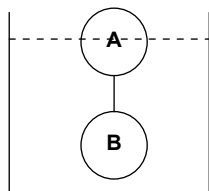
immersed. Find the specific gravity of the liquid in which the hydrometer is immersed upto 0.5 cm.

- (1) 2 (2) 3
(3) 4 (4) 5

12. An ice cube floats in a liquid with 25% of its volume above the liquid surface. If the density of ice is given as 930 kg m^{-3} , then the density of the liquid is _____ g cm^{-3} .

- (1) 2.51 (2) 1.24
(3) 2.45 (4) 4.21

13. A container is filled with a liquid of density 4 g cm^{-3} . Two objects A and B of equal volume are held in equilibrium in the liquid as shown in the figure. The density of the objects A and B are 0.5 g cm^{-3} and 6 g cm^{-3} respectively. What fraction of the total volume of the object A is immersed in the liquid?



- (1) $\frac{8}{5}$ (2) $\frac{3}{5}$
(3) $\frac{5}{8}$ (4) $\frac{1}{5}$

14. A sphere of volume 'V' is immersed in two immiscible liquids (mercury and water) taken in a vessel. If half of the volume of the sphere is in mercury and the other half of its volume is in the water, then the relative density of the sphere is (The densities of mercury and water are 13.6 g cm^{-3} and 1 g cm^{-3} respectively.)

- (1) 7.3 (2) 3.7
(3) 4.7 (4) 5.4

15. The length of a rounded bottomed test tube is 20 cm. The test tube is made to float in two different liquids whose densities are 2 g cm^{-3} and 7 g cm^{-3} respectively. The corresponding depths of immersion of the test tube in the above mentioned liquids are 15 cm and 5 cm respectively. Then relative density of the liquid in which the test tube immerses by 10 is _____.

- (1) 1.5 (2) 3.1
(3) 2.8 (4) 4.2

16. For which of the following options, surface tension is not the basis?

- (1) Rise of sap in trees and plants.
(2) Absorption of water by a blotting paper.

- (3) Rise of oil in an oil wick.
(4) Lifting of an aeroplane wing.

17. An ore of mass 2.1 kg is immersed in a liquid of density 1.8 g cm^{-3} . If the density of the ore is $6.3 \times 10^3 \text{ kg m}^{-3}$, find the upthrust in kgf.

- (1) 62 (2) 60
(3) 0.4 (4) 0.6

18. A balloon of volume 100 m^3 is filled with hot air of density 0.4 kg m^{-3} . The mass of the balloon is 12 kg and a weight 'w' is attached to it. The balloon is coming down to the ground. Find for what value of the weight 'w' the balloon comes down with zero acceleration (neglect the air resistance, take the density of cold air as 1.3 kg m^{-3} and acceleration due to gravity as 10 ms^{-2}).

- (1) 38 kg (2) 48 kg
(3) 78 kg (4) 98 kg

19. Determine the capillary rise in a tube of radius 0.3 mm filled with water. The surface tension of water is 0.075 N m^{-1} , and density of water is 1 g cm^{-3} . (given $g = 10 \text{ ms}^{-2}$)

- (1) 70 mm (2) 30 mm
(3) 50 mm (4) 20 mm

20. The mechanical advantage of a hydraulic press is _____ if the ratio of diameters of the press cylinder to pump cylinder is 2 : 1.

- (1) 8 : 1 (2) 4 : 1
(3) 3 : 2 (4) 1 : 8

21. At constant temperature, if the pressure of a gas of volume V in a container is doubled then the change in its volume is _____.

- (1) V (2) $\frac{V}{2}$
(3) $\frac{V}{4}$ (4) 2V

22. A manometer is connected to a gas container. Then the mercury level rises by 2 cm in the arm of the manometer which is not connected to the container. If the atmospheric pressure is 76 cm of Hg then the pressure of the gas is _____ cm of Hg.

- (1) 80 (2) 76
(3) 72 (4) 78

23. Among the following liquids, the pressure inside them at a given depth is the highest in _____ at a constant temperature.

- (1) fresh water (2) petrol
(3) sea water (4) alcohol

24. A liquid whose density is twice the density of mercury is used as a barometric liquid. Then one atmosphere pressure equals _____ cm of the liquid.
- (1) 76 (2) 38
(3) 152 (4) 380
25. Equal volumes of a liquid is poured into containers A and B such that the area of cross-section of container A is double the area of cross-section of container B. If P_A and P_B are the pressures exerted at the bottom of the containers then $P_A : P_B =$ _____
- (1) 1 : 2 (2) 1 : 1
(3) 3 : 2 (4) 2 : 1
26. A 'U' shaped tube contains oil, carbon tetrachloride and water as shown in the figure. The density of oil is 0.8 g cm^{-3} and that of carbon tetrachloride is 1.6 g cm^{-3} . If oil and water surfaces are at the same level, find the height of the water column.
- (1) 40 cm (2) 35 cm
(3) 15 cm (4) 20 cm
27. The left arm of a manometer is connected to a container containing gas 'X' and the mercury level in the right arm is raised by 2 cm. Now without disconnecting the container of gas X, the right arm of the manometer is connected to another container containing gas 'Y' and the mercury level in the right arm is pushed down by 5 cm. The pressure exerted by the gases 'X' and 'Y' are _____ cm and _____ cm respectively.
- (1) 96, 80 (2) 80, 86
(3) 86, 86 (4) 76, 70
28. An engineer was given a task to measure the rate of increase in pressure at the bottom of an empty cylindrical tank which is filled with water through hose pipe. If the speed of water coming out of the hose pipe is 10 ms^{-1} , diameter and radius of the cylinder and hose pipe are 5 m and 25 cm respectively, find the result shown by the engineer. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 10^3 Pa s^{-1}
(2) 250 Pa s^{-1}
(3) 10^2 Pa s^{-1}
(4) 10^4 Pa s^{-1}
29. A cube of side one meter and having a mass 1200 kg is dropped into a liquid of density 0.5 g cm^{-3} . Then the upthrust acting on the body if the lateral sides are vertical is _____ N. ($g = 10 \text{ ms}^{-2}$)
- (1) 5×10^3 (2) 500
(3) 50 (4) 5×10^4
30. An object of density 3.5 g cm^{-3} suspended from a spring balance is immersed in mercury. The reading on the spring balance is _____ N.
- (1) 350 (2) zero
(3) 35 (4) 65
31. A body weighs 75 g in air, 51 g when completely immersed in a liquid and 67 g when completely immersed in water. Find the density of the liquid.
- (1) 3 g cm^{-3}
(2) 6 g cm^{-3}
(3) 12 g cm^{-3}
(4) 2 g cm^{-3}
32. When a force is applied in the downward direction for a short duration on a body floating with its entire volume in water, the body will then
- (1) float with some part of it above the surface of water.
(2) oscillate in vertical direction.
(3) sink to the bottom.
(4) oscillate in horizontal direction.
33. When equal quantities of an oil, water and mercury are poured into a beaker, the order in which the liquids arrange themselves from bottom to top is
- (1) mercury, water, oil.
(2) water, mercury, oil.
(3) water, oil, mercury.
(4) mercury, oil, water.
34. In a hydrometer, the floatation bulb is large in size compared to the size of the gravity bulb because
- (1) it lowers the centre of gravity.
(2) it decreases the buoyancy of liquids.
(3) it displaces a large amount of liquid and thus does not allow the hydrometer to sink completely in the liquid.
(4) None of these.
35. A metal block of volume 500 cm^3 and density 2 g cm^{-3} is suspended from a spring balance and one fourth of its volume is immersed in water. The reading on the spring balance is _____ N. (Take $g = 10 \text{ ms}^{-2}$)
- (1) 8.575 (2) 10.175
(3) 500 (4) 8.750

ANSWER KEYS

PRACTICE EXERCISE 7 (A)

1. 1	2. 3	3. 1	4. 1	5. 2	6. 1	7. 1	8. 3	9. 2	10. 3
11. 1	12. 2	13. 1	14. 2	15. 4	16. 3	17. 4	18. 1	19. 1	20. 4
21. 4	22. 1	23. 2	24. 1	25. 2	26. 4	27. 4	28. 2	29. 4	30. 4
31. 3	32. 2	33. 4	34. 2	35. 3					

PRACTICE EXERCISE 7 (B)

1. 3	2. 2	3. 1	4. 4	5. 1	6. 1	7. 1	8. 1	9. 1	10. 1
11. 2	12. 2	13. 3	14. 1	15. 2	16. 4	17. 4	18. 3	19. 3	20. 2
21. 2	22. 1	23. 3	24. 2	25. 1	26. 4	27. 2	28. 1	29. 1	30. 2
31. 1	32. 3	33. 1	34. 3	35. 4					

Wave Motion and Sound

SYNOPSIS

- Sound is a form of energy which causes sensation of hearing. It is produced by vibrating bodies.
- The audible range of frequency of sound is 20 Hz – 20 kHz. The sounds with frequencies less than 20 Hz are called infrasonics and the sounds with frequencies greater than 20 kHz are called ultrasonic sound.
- In a longitudinal wave, the particles of the medium vibrate along the direction of propagation of the wave and in a transverse wave the particles of the medium vibrate perpendicular to the direction of propagation of the wave.
- The state of vibrating particle in a wave is called “phase” and is measured in radians.
- The distance between any two successive particles of the wave which are in phase is known as wavelength (λ).
- The maximum displacement of a vibrating particle from the mean position (either upward or downward) in a wave is called amplitude and is measured in metres or centimeters.
- The time taken by a vibrating particle to complete one full vibration (or) the time taken to produce one complete wave pulse is known as time period (T), and the number of vibrations made by a vibrating particle in the wave in one second (or) number of waves

produced per second is known as frequency (n) and is measured in hertz (Hz) and $n = \frac{1}{T}$.

- If the acceleration of an oscillating body is directly proportional to its displacement but opposite in direction to displacement and is directed towards the mean position (i.e., $\bar{a} \propto -\bar{x}$) then the body is said to be in simple harmonic motion (SHM).
- If ‘T’ is the time period of oscillations and ‘ λ ’ is the wavelength of wave propagating, then the velocity (v) of the wave is given by $V = \frac{\lambda}{T} = \lambda \left(\frac{1}{T} \right) = n\lambda$, where n = frequency of the wave.
- The mathematical expression for velocity of sound given by Sir Isaac Newton is $V = \sqrt{\frac{E}{d}}$, where V is the velocity of the waves, E = elastic constant d = density of the medium
 - (a) The elastic constant in solids is given by Young’s modulus (Y) and hence $V = \sqrt{\frac{Y}{d}}$
 - (b) The elastic constant in liquids is given by their bulk modulus of elasticity (K) and hence $V = \sqrt{\frac{K}{d}}$

- The mathematical expression for velocity of sound in air which was given by Laplace is $V = \sqrt{\frac{\gamma p}{d}}$ where ' γ ' is a constant for a given gas and is defined as the ratio of the specific heat capacity of the given gas at constant pressure (C_p) to its specific heat capacity at constant volume (C_v)

$$\gamma = \frac{C_p}{C_v}. \text{ Here, the elastic constant is } \gamma p.$$

- Velocity (V) of sound in a gas is
 - (a) directly proportional to the square root of its absolute temperature.
i.e., $V \propto \sqrt{T} \Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$
 - (b) inversely proportional to the square root of its density (d), i.e., $V \propto \frac{1}{\sqrt{d}}$
 $\Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{d_2}{d_1}}$
 - (c) inversely proportional to the square root of its molecular weight (M) i.e., $V \propto \frac{1}{\sqrt{M}}$
 $\Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{M_2}{M_1}}$

- Velocity of sound in air at a temperature $t^\circ\text{C}$

$$V_t = V_0 \left(1 + \frac{t}{546} \right)$$

Where V_0 is the velocity of sound at 0°C .

- As the persistence of hearing is 0.1 second the minimum distance required to hear an echo is $0 \frac{V}{20}$ m, where V is the velocity of sound in air.
- The apparent frequency (n^1) of sound heard by an observer.

$$n^1 = \left(\frac{V + V_0}{V - V_s} \right) n \text{ Where } V_0 \text{ is the velocity of observer.}$$

This is positive if the observer is moving towards the source and negative if he is moving away from the source. V_s is the velocity of the source. This is positive if the source is moving towards the observer, and negative if the source is moving away from the observer.

- The phenomenon, when the frequency of applied external periodic force is equal to the natural frequency

of vibration of the body on which force is applied, such that it readily takes up the vibrations and begins to vibrate with maximum amplitude is called "resonance".

- In case of stationary waves, the distance between two successive nodes is $\frac{\lambda}{2}$ and the distance between a node and a successive anti-node is $\frac{\lambda}{4}$ and between any two successive anti-nodes is $\frac{\lambda}{2}$.
- The minimum frequency with which a vibrating air column (or) a string vibrates is called fundamental mode of frequency.
- (a) When closed end pipe resonates, the ratio of frequencies of the sound produced is $1 : 3 : 5 \dots$ etc.
(b) The fundamental frequency is given by $n_1 = \frac{V}{4\ell}$ and the frequency of the p^{th} overtone is given by $n(2p + 1) = (2P + 1)n_1 = (2p + 1) \frac{V}{4\ell}$, where ' ℓ ' is length of vibrating air column and $(2p + 1)$ is the harmonic.
- (a) In an open end resonating air column, the ratio of frequencies of the sound waves is $1 : 2 : 3 \dots$
(b) The fundamental mode of frequency is given by $(n_1) = \frac{V}{2\ell}$ and the frequency of p^{th} overtone is given by $n_{p+1} = (p + 1)(n_1) = (p + 1) \left(\frac{V}{2\ell} \right)$. Where ' ℓ ' is length of vibrating air column and $P + 1$ is harmonic.
- Velocity of sound in a resonating air column
 $V = 2n(\ell_2 - \ell_1)$.
Where ' n ' is the frequency of resonating air column, ℓ_1, ℓ_2 are the successive lengths of the resonating air column.
- Velocity of the transverse wave produced in the string is given by $V = \sqrt{\frac{T}{m}}$, where T is the tension in the string and ' m ' is mass per unit length (linear mass density) of the string.
- The fundamental mode of frequency of a vibrating string is $n = \frac{1}{2\ell} \sqrt{\frac{T}{m}}$. Where ℓ, T and m are length of stretched string, tension in the string and linear mass density of the string.
- Laws of vibrating stretched strings: The frequency of a vibrating stretched string, vibrating in a fundamental mode is

- (a) inversely proportional to its length, when its tension and linear density are constant i.e., $n \propto \frac{1}{\ell} \Rightarrow n\ell = \text{constant} \Rightarrow n_1\ell_1 = n_2\ell_2$.
- (b) directly proportional to the square root of its tension, when length and linear mass density remain constant i.e., $n \propto \sqrt{T} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$
- (c) Inversely proportional to the square root of its linear mass density i.e., $n \propto \frac{1}{\sqrt{m}} \Rightarrow n\sqrt{m} = \text{constant} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{m_2}{m_1}}$

- Pitch of a given sound can be measured by its frequency.
- Intensity is a measure of loudness. It is defined as the energy that passes through unit area per unit time.
- (a) Intensity (I) \propto (amplitude)²
- (b) Intensity (I) $\propto \frac{1}{(\text{distance})^2}$
- (c) Intensity (I) \propto density (ρ)
- Where ' ρ ' is the density of the medium through which sound propagates.
- Microphone is an instrument which can convert sound vibrations into electrical signals. These electrical signals can be converted back to sound by using loud speakers.

Solved Examples

1. The ratio of specific heat at constant pressure to that at constant volume (γ) of a gas is 1.5. The density of gas is given as $2 \times 10^{-3} \text{ g cm}^{-3}$. Given that the pressure is equivalent to 80 cm of Hg. Find out the velocity of sound in the gas

(take $g = 1000 \text{ cm s}^{-2}$).

☞ **Solution:** $\gamma = 1.5$

$$P = 80 \text{ cm of Hg} = 80 \times 13.6 \times 1000$$

$$= 1088 \times 10^3 \text{ dynes cm}^{-2}$$

$$d = 2 \times 10^{-3} \text{ g cm}^{-3}$$

$$\text{Velocity of sound, } V = \sqrt{\frac{\gamma P}{d}}$$

$$= \sqrt{\frac{1.5 \times 1088 \times 10^3}{2 \times 10^{-3}}} = 28.56 \times 10^3 \text{ cm s}^{-1}$$

$$= 285.6 \text{ ms}^{-1}$$

2. The Young's modulus of a solid is given by $6.25 \times 10^{11} \text{ dynes cm}^{-2}$. If the velocity of sound in the solid is 2500 ms^{-1} , find its density.

☞ **Solution:** Velocity of sound in a solid

$$V = \sqrt{\frac{Y}{d}} \Rightarrow \text{density,}$$

$$d = \frac{Y}{V^2} = \frac{6.25 \times 10^{11}}{(250000)^2}$$

$$= \frac{625 \times 10^9}{625 \times 10^8} = 10 \text{ g cm}^{-3}$$

3. The velocity of sound in oxygen is 100 ms^{-1} . Find the velocity of sound in hydrogen at the same temperature and pressure as that of oxygen.

☞ **Solution:** Velocity of sound in a gas,

$$V \propto \frac{1}{\sqrt{\text{Molecular weight (M)}}} \Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\Rightarrow \frac{V_{\text{H}_2}}{V_{\text{O}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}} = \sqrt{\frac{32}{2}} = \sqrt{16} = 4.$$

$$\Rightarrow V_{\text{H}_2} = 4 \times V_{\text{O}_2} = 4 \times 100 = 400 \text{ ms}^{-1}$$

4. A person standing at a distance 200 m from a hill blows a horn. After what time can he hear the echo? (Given that the velocity of sound in air is 300 ms^{-1}).

☞ **Solution:** Let ' d ' be the distance of reflection from source then $v = \frac{2d}{t}$
' t ' is time taken to receive the echo.

$$t = \frac{2d}{v} = \frac{2 \times 200}{300} = \frac{400}{300} = \frac{4}{3} \text{ s.}$$

5. A person trying to determine the velocity of sound in air produces a sound at a certain time and hears the echo after 10 seconds. If the reflector is at a distance of 1700 m, find the velocity of sound in air.

☞ **Solution:** Velocity of sound, $V = \frac{2d}{t} = \frac{3400}{10} = 340 \text{ ms}^{-1}$

6. In a resonating air column method the first and second resonating lengths are recorded as 25 cm and 75 cm respectively. If the velocity of sound is 300 ms^{-1} , find the frequency of tuning fork used.

☞ **Solution:** $V = 300 \text{ ms}^{-1}$
 $\ell_1 = 25 \text{ cm} = 0.25 \text{ m}$, $\ell_2 = 75 \text{ cm} = 0.75 \text{ m}$,
 $V = 2n(\ell_2 - \ell_1)$

$$n = \frac{V}{2(\ell_2 - \ell_1)} = \frac{300}{2(0.75 - 0.25)} = 300 \text{ Hz}.$$

7. In a sonometer experiment the mass suspended from the string is 1 kg. The resonating length for a given tuning fork is noted as 20 cm. If the mass suspended is increased to 4 kg, find the resonating length of the string for the same frequency.
 $(g = 10 \text{ ms}^{-2})$

☞ **Solution:** In a stretched string $n = \frac{1}{2\ell} \sqrt{\frac{T}{m}}$
 Given n is a constant and for a given string m is also constant.

$$\therefore \frac{\sqrt{T}}{\ell} = \text{constant}$$

$$\therefore \frac{\sqrt{T_1}}{\ell_1} = \frac{\sqrt{T_2}}{\ell_2} \Rightarrow T_1 = 1 \text{ kg} \times 10 = 10 \text{ N}, T_2 = 4 \text{ kg} \times 10 = 40 \text{ N}$$

$$\frac{\ell_2}{\ell_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{40}{10}} = \sqrt{4} = 2$$

$$\ell_2 = 2 \ell_1 = 2 \times 20 = 40 \text{ cm}$$

8. A source of longitudinal waves vibrates 320 times in two seconds. If the velocity of this wave in the air is 240 ms^{-1} , find the wavelength of the wave.

☞ **Solution:** Velocity of wave, $v = 240 \text{ ms}^{-1}$.

$$\text{Frequency of the wave, } n = \frac{320}{2} = 160 \text{ hertz}.$$

$$\text{Velocity of wave, } v = n\lambda.$$

$$\text{Wavelength, } \lambda = \frac{v}{n} = \frac{240}{160} = 1.5 \text{ m}.$$

9. The distance between any two successive anti-nodes or nodes of a stationary wave is 0.75 m. If the velocity of the wave is 300 ms^{-1} , find the frequency of the wave.

☞ **Solution:** Distance between successive anti-nodes

$$\frac{\lambda}{2} = 0.75 \text{ m}.$$

$$\text{Wavelength of the wave, } \lambda = 0.75 \text{ m} \times 2 = 1.5 \text{ m}.$$

$$\text{Velocity of the wave} = 300 \text{ ms}^{-1}.$$

$$\begin{aligned} \text{frequency, } n &= \frac{v}{\lambda} \\ &= \frac{300}{1.5} = 200 \text{ hertz}. \end{aligned}$$

10. A source of sound is moving towards a platform with a velocity of 100 ms^{-1} . If the frequency of sound produced is 200 Hz, find the apparent frequency of the sound as observed by an observer standing on the platform (take the velocity of sound = 320 ms^{-1}).

☞ **Solution:** Velocity of sound, $v = 320 \text{ ms}^{-1}$.

$$\text{Velocity of source, } v_s = 100 \text{ ms}^{-1}.$$

$$\text{Frequency of sound, } n = 200 \text{ Hz}.$$

$$\text{Apparent frequency of sound} = \frac{vn}{v - v_s}$$

$$= \frac{320 \times 200}{320 - 100} = \frac{320 \times 200}{220}$$

$$= \frac{6400}{22} \cong 290 \text{ Hz}.$$

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

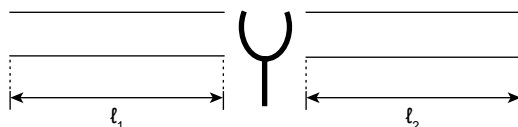
1. Hertz is the unit of
 - (1) wavelength
 - (2) amplitude
 - (3) frequency
 - (4) None of these
2. The velocity of sound in air depends upon
 - (1) its density and pressure only.
 - (2) its ratio of specific heat and pressure only.
 - (3) its ratio of specific heats and density only.
 - (4) its ratio of specific heat capacities, density and pressure.
3. If the velocity of sound in a gas is 200 ms^{-1} when the temperature is 127°C , then the velocity of sound in the same gas when temperature is increased by 900°F is _____ ms^{-1} .
 - (1) $200\sqrt{3}$
 - (2) 300
 - (3) $100\sqrt{5}$
 - (4) 450
4. The ratio of intensities of two sound waves is 16 : 25. The ratio of their amplitudes is
 - (1) 1 : 2
 - (2) 5 : 4
 - (3) 2 : 1
 - (4) 4 : 5
5. In a stationary wave,
 - (1) in a given loop, the particles of the medium are in phase.
 - (2) energy is confined to a limited region of the medium.
 - (3) different particles in a loop have different amplitudes.
 - (4) All the above.
6. The frequency of sound waves is 11 kHz and its wavelength is 20 cm, then the velocity of sound waves is _____.
 - (1) 220 ms^{-1}
 - (2) 220 cm s^{-1}
 - (3) 2200 cm s^{-1}
 - (4) 2200 ms^{-1}
7. Before recording any sound on a magnetic tape the molecules of the magnetic tape align such that the net magnetic moment is _____.
 - (1) one
 - (2) maximum
 - (3) zero
 - (4) -1
8. In a resonating air column, the first booming sound is heard when the length of air column is 10 cm. The second booming sound will be heard when the length is _____ cm.
 - (1) 20
 - (2) 30
 - (3) 40
 - (4) None of the above
9. In an open pipe pressure at the ends of the pipe is
 - (1) minimum
 - (2) maximum
 - (3) zero
 - (4) depending on temperature, it can be maximum or minimum.
10. The ratio of frequencies of 1st and 2nd overtones produced in the vibrating stretched strings is _____.
 - (1) 1 : 3
 - (2) 3 : 2
 - (3) 2 : 3
 - (4) 1 : 2
11. A particle executing SHM completes 120π vibrations in one minute. What is the frequency of this motion?
 - (1) 5 Hz
 - (2) 2π Hz
 - (3) 1 Hz
 - (4) None of the above.
12. The minimum distance between the particles in a medium vibrating with the same phase is known as
 - (1) amplitude
 - (2) wavelength
 - (3) frequency
 - (4) phase
13. A sound wave propagates in a medium which has the property/properties of
 - (1) inertia
 - (2) elasticity
 - (3) Both (1) and (2)
 - (4) Neither (1) nor (2)
14. At S.T.P. the ratio of volumes occupied by 1 mole of each O_2 and CO_2 gases respectively is _____.
 - (1) 4 : 1
 - (2) 1 : 4
 - (3) 1 : 2
 - (4) 1 : 1
15. If wind blows in a direction opposite to the sound propagation, then the velocity of the sound
 - (1) increases
 - (2) decreases
 - (3) remains constant
 - (4) Cannot be determined
16. A body travelling with a speed of more than the velocity of sound in air is said to travel with
 - (1) supersonic speed
 - (2) hypersonic speed
 - (3) ultrasonic speed
 - (4) infrasonic speed

17. When a sound wave passes from a highly polluted region to a pollution-free area, which of the following physical quantities remain unaltered?
- (1) Amplitude (2) Velocity
(3) Frequency (4) Wavelength
18. Which of the following is not the law of stretched string? (n , ℓ , T and m are frequency of vibration, length of vibrating string, tension in string and linear mass density respectively.)
- (1) $n \propto \frac{1}{\sqrt{T}}$ (2) $n \propto \frac{1}{\ell}$
(3) $n \propto \frac{1}{\sqrt{m}}$ (4) All the above
19. The amplitude of a sound wave at a distance of 2 m from the source is 0.3 m. What is the amplitude if the distance is increased by 1 metre?
- (1) 0.2 m (2) 2 m
(3) 0.6 m (4) 6 m
20. The velocity of sound in a gas at 0 °C is 335 ms⁻¹. If its γ value is 1.4, find the molecular weight of the gas. [Hint: for an ideal gas, $\frac{p}{\rho} = \frac{RT}{M}$ and $R = 8.3 \text{ J K}^{-1} \text{ mole}^{-1}$].
- (1) 14 g (2) 28 g
(3) 36 g (4) 14 g
21. A person drops a metallic sphere from the top of a tower of height 125 m. Another person at a distance of 80 m from the foot of the tower hears the sound of the sphere hitting the ground after a time interval of 5.25 s. Find the velocity of the sound in air. ($g = 10 \text{ ms}^{-2}$)
- (1) 140 ms⁻¹ (2) 280 ms⁻¹
(3) 320 ms⁻¹ (4) 460 ms⁻¹
22. A source of sound at rest produces sound waves, which move with velocity v . Wind blows with velocity $0.25v$ away from an observer standing at a distance from the source. Find the percentage change in the wavelength and frequency of the sound as heard by the observer.
- (1) 75% (2) 50%
(3) 100% (4) 25%
23. A man stands in front of a cliff and finds that when he claps at regular time interval of 1.2 seconds, he does not hear the echo distinctly. Then he moves closer to the cliff by 32 m and finds that he cannot hear the echo distinctly when he claps at an interval of 1 second. Find the velocity of sound waves.
- (1) 160 ms⁻¹ (2) 320 ms⁻¹
(3) 250 ms⁻¹ (4) 380 ms⁻¹
24. A person drops a stone in a well of depth 80 m and hears the sound of splash after 4.25 seconds. If the acceleration due to gravity is 10 ms^{-2} , find the velocity of sound in air.
- (1) 320 ms⁻¹ (2) 160 ms⁻¹
(3) 480 ms⁻¹ (4) 80 ms⁻¹
25. When a tuning fork of 500 Hz is used, the first and second resonating lengths of closed air column are found to be 18 cm and 54 cm respectively. Find the velocity of sound in S.I. system.
- (1) 120 ms⁻¹ (2) 240 ms⁻¹
(3) 360 ms⁻¹ (4) 480 ms⁻¹
26. A string is stretched by a tension of 200 N. If its linear density is $2 \times 10^{-2} \text{ kg m}^{-1}$, what is the velocity of waves set in the string?
- (1) 200 ms⁻¹ (2) 50 ms⁻¹
(3) 550 ms⁻¹ (4) 100 ms⁻¹
27. A block of mass 3 kg is suspended from the ceiling of a lift through a string having a linear density of $32.4 \times 10^{-3} \text{ kg m}^{-1}$. Find the speed with which a wave can move on the string, if the lift accelerates upward at a rate of 2 ms^{-2} . Take $g = 10 \text{ ms}^{-2}$
- (1) 33.3 ms⁻¹ (2) 66.6 ms⁻¹
(3) 99.9 ms⁻¹ (4) 22.2 ms⁻¹
28. An open pipe of length 12 cm in its fundamental mode vibrates in resonance with the first overtone of a closed organ pipe of length 13.5 cm, which is filled with some gas. If the velocity of sound in air is 320 ms⁻¹, find the velocity of sound in the unknown gas?
- (1) 180 ms⁻¹ (2) 240 ms⁻¹
(3) 110 ms⁻¹ (4) 135 ms⁻¹
29. Two wires of same material and area of cross section each of length 30 cm and 40 cm are stretched between two ends with tensions 10 N and 20 N respectively. The difference between the fundamental frequencies of two wires is 4.0 Hz. Find the linear mass density of the wire.
- (1) $16.4 \times 10^{-4} \text{ kg m}^{-1}$
(2) $16.4 \times 10^{-3} \text{ kg m}^{-1}$
(3) $6.4 \times 10^{-3} \text{ kg m}^{-1}$
(4) $6.4 \times 10^{-5} \text{ kg m}^{-1}$

30. A sonometer resonates with a given tuning fork forming stationary waves with 8 anti-nodes between the two pegs, when a load of 9 kg is suspended from the wire. When this load is increased by 7 kg then the wire resonates with same tuning fork. Find the number of antinodes formed between the two pegs when load is increased.

(1) 1 (2) 3
(3) 6 (4) 9

31. A vibrating tuning fork is held between an open organ pipe and a closed organ pipe of lengths ℓ_1 and ℓ_2 respectively as shown in the figure.



If the first overtones are produced in each organ pipe, find the ratio of the lengths of the two organ pipes.

(1) 3 : 2 (2) 3 : 1
(3) 4 : 1 (4) 4 : 3

32. The distance between two adjacent particles which are in the same phase in a progressive wave is 20 cm. Determine the velocity of the wave if its frequency is 10 Hz.

(1) 4 ms^{-1} (2) 40 ms^{-1}
(3) 8 ms^{-1} (4) 80 ms^{-1}

33. From the string of a sonometer a constant weight is suspended. The resonating length of the string is noted as 50 cm for a tuning fork of 200 Hz. If a tuning fork of 250 Hz is used, what should be the distance between two knife edges to get resonance?

(1) 300 cm (2) 40 cm
(3) 140 cm (4) 20 cm

34. A bat emits ultrasonic sound of frequency 50 kHz in air. If this sound meets a glass surface, what is the wavelength of

(a) the reflected sound,
(b) the transmitted sound? (Take the speed of sound in air is 350 ms^{-1} , and in glass is 5000 ms^{-1})

(1) 0.7 cm, 30 cm (2) 1.4 cm, 60 cm
(3) 0.7 cm, 10 cm (4) 1.4 cm, 40 cm

35. A source of sound is moving away from an observer at rest with a velocity of 50 ms^{-1} . If the frequency of sound is 200 Hz, find the apparent frequency observed by the observer. (Take velocity of sound = 300 ms^{-1})

(1) 140 Hz (2) 25.1 Hz
(3) 171.4 Hz (4) 75.6 Hz

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The ratio of densities of two media is 5 : 2. Then, the ratio of intensities of a given sound wave in the two media is

(1) 25 : 4 (2) 2 : 5
(3) 5 : 2 (4) 1 : 1

2. The audible range of frequency of sound waves for human beings is _____.

(1) 10 Hz to 10,000 Hz
(2) 20 Hz to 20,000 Hz
(3) 5 Hz to 50,000 Hz
(4) 50 Hz to 20,000 Hz

3. Which of the following quantity decreases as sound wave travels through a medium?

(1) Amplitude (2) Frequency
(3) Velocity (4) Wavelength

4. If the amplitude of a sound is doubled, then its

(1) velocity is doubled.
(2) frequency is doubled.
(3) wavelength is doubled.
(4) None of the above.

5. A man blows a whistle and hears an echo after 1.2 seconds. The distance between the man and the reflector of the sound is _____ m. (take velocity of sound in air as 330 ms^{-1}).

(1) 250 (2) 190
(3) 298 (4) 198

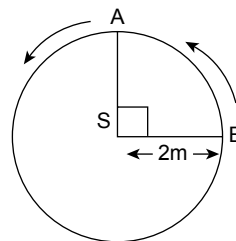
6. A man moving towards a vertical cliff at a constant velocity of $u \text{ ms}^{-1}$, fires a bullet and hears the echo

after t s. If he was at a distance of d m from the cliff when he fired the bullet, the velocity of sound in air is _____ ms^{-1} .

- (1) $\frac{2d}{t}$ (2) $\frac{2d}{t} + u$
 (3) $\frac{2d}{t} - u$ (4) $\frac{d}{t}$

7. For a body executing simple harmonic motion
 (1) acceleration is directly proportional to the displacement
 (2) restoring force acts towards the mean position
 (3) amplitude is constant
 (4) All the above.
8. In a closed end organ pipe, if ℓ_1 and ℓ_2 are two successive resonating lengths, then $2(\ell_2 - \ell_1)$ is _____.
 (1) $\lambda/2$ (2) λ
 (3) 2λ (4) None of these
9. A loud rattling sound is produced by a car at some particular speed. This phenomenon is due to
 (1) resonance.
 (2) natural vibrations.
 (3) defect in the design of the car.
 (4) None of the above
10. The general expression for the resonating length of an air column in organ pipes with one end closed is given by _____.
 (1) $\frac{(2n-1)\lambda}{2}$ (2) $\frac{n\lambda}{4}$
 (3) $\frac{(2n-1)\lambda}{4}$ (4) $\frac{(n+1)\lambda}{2}$
11. If wind blows in a direction opposite to the sound propagation, then the velocity of the sound
 (1) increases
 (2) decreases
 (3) remains constant
 (4) Cannot be determined
12. The velocity of sound in a gas is 30 ms^{-1} at 27°C . What is the velocity of the sound in the same gas at 127°C ?
 (1) 20 ms^{-1} (2) 30 ms^{-1}
 (3) $20\sqrt{3} \text{ ms}^{-1}$ (4) 60 ms^{-1}
13. A source which is situated at the centre of a circle is producing sound. Then the change in frequency

(f) of sound heard by two persons at 'A' and 'B' if they move with velocities 20 ms^{-1} and 10 ms^{-1} respectively along the circular path as shown in figure is _____. (Velocity of sound is 330 ms^{-1})



- (1) $2f$ (2) f
 (3) zero (4) None of these
14. The phenomenon of apparent change in the frequency of sound whenever there is relative motion between the source of sound and the observer is called _____.
 (1) Photo electric effect (2) Doppler effect
 (3) Reflection (4) Refraction
15. If ' v ' is the velocity of sound in a gas then ' v ' is directly proportional to (where M , d and T represents molecular weight of gas, density of gas and its temperature respectively.)
 (1) \sqrt{M} (2) $\frac{1}{\sqrt{d}}$
 (3) \sqrt{T} (4) Both (2) and (3)
16. Velocity (v) of sound in air, by vibrating resonating column is found by _____ (ℓ_1 , ℓ_2 and n are first second resonating lengths and frequency of tuning fork used respectively).
 (1) $v = 2(\ell_2 - \ell_1)$ (2) $\frac{v}{n} = (\ell_2 - \ell_1)$
 (3) $v = \frac{(\ell_2 - \ell_1)}{2n}$ (4) $v = 2n(\ell_2 - \ell_1)$
17. Find the ratio of velocities of sound in hydrogen to oxygen at STP. The γ values of hydrogen and oxygen are same.
 (1) 4 : 1 (2) 1 : 4
 (3) 2 : 3 (4) 4 : 3
18. The velocity of sound produced in a metal is 4500 ms^{-1} . If the density of the metal is $8 \times 10^3 \text{ kg m}^{-3}$, find the Young's modulus of the metal in GPa.
 (1) 86 GPa (2) 162 GPa
 (3) 246 GPa (4) 110 GPa

19. A scooterist is at a distance of 150 m from a wall. He blows a horn after 1 s when he starts moving away from the wall with a velocity of 12 ms^{-1} . If he hears the echo after 1 s, find the velocity of sound in air.
- (1) 336 ms^{-1} (2) 146 ms^{-1}
 (3) 212 ms^{-1} (4) 120 ms^{-1}
20. A simple pendulum which has a bob made of metal oscillates with a time period T . The bob of the pendulum is immersed in a non-viscous liquid and then oscillated. If the density of the metal bob is 5 times the density of the liquid, then find the time period of the pendulum.
- (1) $\sqrt{\frac{1}{4}}T$ (2) $\sqrt{\frac{5}{4}}T$
 (3) $\sqrt{\frac{1}{5}}T$ (4) $\sqrt{\frac{4}{5}}T$
21. A pointer is attached to the prong of a tuning fork of frequency 56 Hz mounted on a stand such that the pointer strikes the vertical plate as the tuning fork vibrates. If the vertical plate falls freely from rest through 10 cm, find how many times the pointer strikes the plate during the descent of the plates?
- (1) 14 (2) 12
 (3) 8 (4) 4
22. The first resonating length of a closed end air column is 30 cm. At approximately, what length of the air column do we obtain the second resonance?
- (1) 90 cm (2) 30 cm
 (3) 170 cm (4) 140 cm
23. If the tension in a stretched string is quadrupled, find the change in the fundamental frequency of the transverse wave that can be created in the stretched string.
- (1) thrice the original frequency
 (2) $\frac{1}{2}$ (original frequency)
 (3) original frequency
 (4) twice the original frequency
24. A wire is stretched between two points with a tension 200 N, whose linear density is $5 \times 10^{-3} \text{ kg m}^{-1}$. The wire resonates at a frequency of 170 Hz. The next higher frequency at which the same wire resonates is 210 Hz. What is the length of the wire?
- (1) 1.2 m (2) 2.5 m
 (3) 4.5 m (4) 1.0 m
25. A sonometer wire of length 1.3 m is fixed between two ends. Where should the bridges be placed on the table below the wire, from its either ends such that the three segments of the wire have their fundamental frequencies in the ratio 2 : 3 : 4?
- (1) 0.6 m, 0.3 m (2) 1.3 m, 0 m
 (3) 0 m, 1.3 m (4) 0.3 m, 0.3 m
26. A straight wire is made up of two copper wires welded in the middle. This wire is used as a sonometer wire. Stationary waves are set up in the wire with tension T and welded joint as node. If one half of the wire vibrates with 3 loops and the other half with 6 loops, find the ratio of velocities of the waves in one half to that in the other half of the wire. Is the thicknesses of each half of wire same? If no, find the ratio of the radii of each half of the wires.
- (1) 1 : 2 (2) 2 : 3
 (3) 3 : 1 (4) 1 : 4
27. In a resonating air column method, two tuning forks of frequency 300 Hz and 400 Hz are used. The first tuning fork gives a loud sound at a minimum length of 27 cm of resonating tube while the other gives loud sound at a minimum length of 20 cm. Determine the velocity of sound waves in air.
- (1) 268 ms^{-1} (2) 180 ms^{-1}
 (3) 336 ms^{-1} (4) 440 ms^{-1}
28. In an experiment, a closed organ pipe of length ℓ was filled with a gas A at an atmospheric pressure and the fundamental note was produced when a tuning fork of certain frequency was held above the pipe. When a gas B, at an atmospheric pressure was filled in the organ pipe, the first overtone was obtained for the same length with the same turning fork. If $\gamma_A : \gamma_B = 2 : 1$, find the ratio of densities of the two gases.
- (1) 2 : 1 (2) 9 : 1
 (3) 1 : 4 (4) 2 : 9
29. A source of wave vibrates with a frequency 500 Hz. The wave travels 33 m in 0.1 s. How far does the waves travels when the source executes 150 vibrations?
- (1) 11 m (2) 99 m
 (3) 66 m (4) 128 m
30. The average speed of the to bob of a seconds pendulum is 2 ms^{-1} . Determine the frequency of oscillation.
- (1) 0.5 Hz (2) 1.5 Hz
 (3) 0.9 Hz (4) 2 Hz

31. The frequency of fundamental mode of vibration of a stretched string fixed at both the ends is 25 Hz. If the string is made to vibrate with 7 nodes then what is the frequency of vibration? If the length of string is 3 m then what is the frequency of 4th harmonic.
- (1) 100 Hz (2) 50 Hz
(3) 150 Hz (4) 250 Hz
32. The frequency of fundamental mode of vibration of an air column enclosed in a closed end pipe is 250 Hz. If its length is 33 cm, then find the velocity of sound in air.
- (1) 390 ms^{-1} (2) 160 ms^{-1}
(3) 330 ms^{-1} (4) 150 ms^{-1}
33. Srikanth took a rope of uniform mass 0.1 kg and length 2.5 m. He tied the rope tightly between the two walls and disturbed it to vibrate. Then he noticed that the speed of a transverse wave progressing in the rope is 5 ms^{-1} and measured the tension in the rope. Find his answer.
- (1) 3 N (2) 0.5 N
(3) 2 N (4) 1 N
34. Two trains A and B are approaching each other with 108 km h^{-1} and 126 km h^{-1} respectively. If the train 'A' sounds a whistle of frequency 500 Hz, find the frequency of the whistle as heard by a passenger in the train 'B'.
- (a) before the trains cross each other and
(b) after the trains cross each other. (Take velocity of sound as 330 ms^{-1})
- (1) 608 Hz, 410 Hz
(2) 410 Hz, 608 Hz
(3) 330 Hz, 550 Hz
(4) 310 Hz, 660 Hz
35. Calculate the minimum distance to hear an echo. (taking the velocity of sound in air to be 330 ms^{-1}).
- (1) 12.8 m (2) 24 m
(3) 8.6 m (4) 16.5 m

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 2 | 4. 4 | 5. 4 | 6. 4 | 7. 3 | 8. 2 | 9. 1 | 10. 3 |
| 11. 2 | 12. 2 | 13. 3 | 14. 4 | 15. 2 | 16. 1 | 17. 3 | 18. 1 | 19. 1 | 20. 2 |
| 21. 3 | 22. 4 | 23. 2 | 24. 1 | 25. 3 | 26. 4 | 27. 1 | 28. 2 | 29. 3 | 30. 3 |
| 31. 4 | 32. 1 | 33. 2 | 34. 3 | 35. 3 | | | | | |

PRACTICE EXERCISE 8 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 2 | 3. 1 | 4. 4 | 5. 4 | 6. 3 | 7. 4 | 8. 2 | 9. 1 | 10. 3 |
| 11. 2 | 12. 3 | 13. 3 | 14. 2 | 15. 4 | 16. 4 | 17. 1 | 18. 2 | 19. 1 | 20. 2 |
| 21. 3 | 22. 1 | 23. 3 | 24. 2 | 25. 1 | 26. 1 | 27. 3 | 28. 4 | 29. 2 | 30. 1 |
| 31. 1 | 32. 3 | 33. 4 | 34. 1 | 35. 4 | | | | | |

Modern Physics

SYNOPSIS

- Every atom is composed of three subatomic particles
 - (i) negatively charged electrons,
 - (ii) positively charged protons and
 - (iii) neutrons having no net electric charge.
- In a neutral atom, the number of protons is equal to the number of electrons.
- The mass of a subatomic particle is generally expressed in atomic mass unit (a.m.u) and one atomic mass unit is defined as $1/12^{\text{th}}$ mass of C-12 atom. $1 \text{ amu} = 1.6605402 \times 10^{-27} \text{ kg}$
- The protons and neutrons are held together in the nucleus by nuclear force.
- The atomic number (z) is the number of protons in a nucleus.
- The mass number (A) refers to the total number of nucleons. That is number of neutrons and protons together.
- Electrons revolve around the nucleus in fixed circular orbits having well defined energy levels.
- When an electron moves from a higher energy level to a lower energy level, the difference in the energy levels is emitted as radiation. When it moves from a lower energy level to a higher energy level, the difference in energy is absorbed.
- Atoms of the same element having the same atomic number but, different mass number are known as isotopes.
- An electric discharge tube is a device that is used to study the flow of charges (current) through gases.
- The rays emitted from cathode are known as cathode rays which consists of electrons.
- Gases conduct electricity at sufficiently high potential differences and at low pressures. This is known as electric discharge.
- When high speed electrons are stopped by certain objects like metals, X-rays are produced.
- Charge on electron is equal to $-1.6 \times 10^{-19} \text{ C}$ and its mass is equal to $9.11 \times 10^{-31} \text{ kg}$.
- The charge to mass ratio of an electron (e/m ratio) is given as $1.76 \times 10^{11} \text{ C kg}^{-1}$.
- X-rays are electromagnetic radiations, travel in a straight line with a velocity of light ($3 \times 10^8 \text{ ms}^{-1}$) in free space, their wavelength is very short of the order of 1 \AA , they are not affected by electric and magnetic fields.
- Radioactivity is the phenomenon of disintegration and spontaneous emission of radiations by some unstable nuclei. Substances which give such spontaneous emission of radiations are known as radioactive substances.

- The radiations of radioactive substance consist of three distinct constituents alpha (α), beta (β) and gamma (γ) radiations.
- α (alpha) rays are same as ionized helium atoms, they are positively charged particles.
- β (Beta) rays are highly energized electrons, they are negatively charged particles.
- γ -(gamma) rays are high energy electromagnetic radiation, they are electrically neutral, they are undeflected when passing through electric or magnetic fields.
- When an α -particle is emitted from a radioactive nucleus, the atomic number (Z) decreases by 2 and the mass number (A) decreases by 4.
- Whenever a β -particle is emitted from a radioactive nucleus, the atomic number increases by 1 where as the mass number remains the same.
- There is no change in the atomic number (Z) or in the mass number (A) of the atom which undergoes γ decay, the emission of γ -ray results in a change in the energy state of the nucleus.
- The law of radioactive disintegration states that in any radioactive substance, the number of atoms disintegrating per second $-\left(\frac{\Delta N}{\Delta t}\right)$ is directly proportional to the number of atoms present.

$$\frac{\Delta N}{\Delta t} = -\lambda N, \text{ where } \lambda \text{ is decay constant.}$$
- $N = N_0 e^{-\lambda t}$ where N_0 and N are the total number of atoms of a radioactive substance at instants when time is zero and 't' respectively and 'e' is an irrational number. λ is decay constant its value is $0.693/T$.
- The process of estimating the age by measuring the disintegration of C - 14 is known as 'carbon dating'.
- Background radiations are those radioactive radiations that everyone is exposed due to the presence of natural radioactive substance on the earth as well as the cosmic radiations and also the radioactive substances present in the body.
- The difference between the sum of the individual masses of constituents in a nucleus and the mass of the nucleus itself is called the 'mass defect'.
- Einstein's mass-energy equivalence is given as $E = (\Delta m) c^2$.
 Δm is the change in mass and c is the velocity of light in vacuum.
 Thus mass of 1 u = 931.5×10^6 eV.
- Nuclear fission is a process in which the heavy nucleus of a radioactive substance is split into lighter nuclei by the bombardment of a low energy neutron, the reaction being accompanied by the release of energy and two or three or more neutrons.
- A nuclear reaction combining nuclei of lighter atoms together to form heavier nuclei resulting in the release of tremendous amount of energy is called a nuclear fusion reaction.

Solved Examples

1. If $\frac{7}{8}$ of the initial mass of a radioactive substance decays in 15 days, then what is the half-life period of the radioactive substance?

Solution: Let the initial number of radioactive nuclei be N_0 .

Then, after a half-life period, the number of nuclei present would be $N_0 \times \frac{1}{2}$.

After two half-lives, the number of nuclei present would be $\frac{1}{2} \times \left(N_0 \times \left(\frac{1}{2} \right) \right) = N_0 \left(\frac{1}{2} \right)^2$

Similarly, after 'n' half-lives, the number of nuclei

$$\text{present would be } N = N_0 \left(\frac{1}{2} \right)^n \quad \rightarrow (1)$$

If 't' is the given time period and T is the half-life period of the radioactive substance,

$$\text{then } n = \frac{t}{T} \quad \rightarrow (2)$$

Also, if 'mo' is the initial mass and 'm' the mass of undecayed nuclei of the substance,

$$\text{then } \frac{N}{N_0} = \frac{m}{m_0} \quad \rightarrow (3)$$

∴ Equation (1) can be written as

$$m = m_0 \left(\frac{1}{2} \right)^n \text{ or } m = m_0 \left(\frac{1}{2} \right)^{\frac{t}{T}} \rightarrow (4)$$

In the given problem, undecayed mass

$$m = m_0 - \frac{7}{8}m_0 = \frac{1}{8}m_0; t = 15 \text{ days}, T = ?$$

Substituting the values of 'm', 'm₀' and 't' in equation (4), we get

$$\frac{1}{8}m_0 = m_0 \left(\frac{1}{2} \right)^{\frac{15}{T}} \Rightarrow \frac{1}{8} = \left(\frac{1}{2} \right)^{\frac{15}{T}} \Rightarrow \left(\frac{1}{2} \right)^3 = \left(\frac{1}{2} \right)^{\frac{15}{T}}$$

$$\Rightarrow \frac{15}{T} = 3 \Rightarrow T = \frac{15}{3} \text{ days} = 5 \text{ days}$$

2. Calculate of mass of helium nucleus. [Mass of proton is 1.0078 u and mass of neutron is 1.0087 u]

☞ **Solution:** Consider a helium atom ${}_2\text{He}^4$.

It has 2 electrons, 2 protons and 2 neutrons.

The mass of a proton = 1.0078 u; The mass of a neutron = 1.0087 u.

$$\therefore \text{The total mass of the nucleus} = 2 \times 1.0078 + 2 \times 1.0087 = 4.0330 \text{ u}$$

3. What is the energy required to increase the mass of a system by one atomic mass unit?

☞ **Solution:** $\Delta m = 1 \text{ u}$

$$E = 1 \times 931.5 \text{ MeV} = 931.5 \text{ MeV}$$

4. In a given radio-active sample, there are 10^{24} nuclei present. If its half life period is 20 years, how many nuclei will be present after 10 years? (Take $1/\sqrt{2} = 0.707$)

☞ **Solution:** The number of nuclei (N) present after 'n' half lives is given by

$$N = N_0 \left(\frac{1}{2} \right)^n \rightarrow (1) \text{ Where } n = \frac{t}{T}$$

In the question, we are given that $N_0 = 10^{24}$; $n = 10/20 = \frac{1}{2}$; $N = ?$

Substituting the above values in equation (1), we get

$$N = 10^{24} \left(\frac{1}{2} \right)^{\frac{1}{2}} = 10^{24} \times 0.707 = 7.07 \times 10^{23}$$

5. Calculate the binding energy per nucleon for Beryllium ${}_4\text{Be}^9$, its mass being 9.012 u. The masses of proton and neutron are 1.008 u and 1.009 u. (Take $1 \text{ u} = 931.5 \text{ MeV}$)

☞ **Solution:** First, let us find the mass defect. The Beryllium nucleus contains 4 protons and 5 neutrons.

Mass of 4 protons = $4 \times 1.008 = 4.032 \text{ u}$; Mass of 5 neutrons = $5 \times 1.009 \text{ u} = 5.045 \text{ u}$

Total mass of protons (4) and neutrons (5) = $4.032 + 5.045 = 9.077 \text{ u}$

Mass defect = $9.077 - 9.012 = 0.065 \text{ u}$

The mass defect converted into equivalent energy gives binding energy.

$$1 \text{ u} = 931.5 \text{ MeV}$$

$$\therefore 0.065 \text{ u} = 0.065 \times 931.5 \text{ MeV} = 60.5475 \text{ MeV}$$

Binding energy per nucleon

$$= \frac{\text{Binding energy}}{\text{No. of nucleons}} = \frac{60.5475}{9} = 6.7275 \text{ MeV}$$

6. In a Coolidge tube, high speed electrons emitted from the cathode are accelerated through a potential difference of 20 kV. Find the minimum wavelength of the X-rays produced.

(Take Planck's constant, $h = 6.6 \times 10^{-34} \text{ J s}$)

☞ **Solution:** When electrons are accelerated through a potential difference, the work done on them is equal to the change in their kinetic energy. When cathode rays are stopped, they lose kinetic energy which is then converted into X-rays.

Thus, Work done on cathode rays (W)

$$= V \times q = \frac{1}{2}mv^2. \rightarrow (1)$$

The energy and frequency of X-rays (any radiation) is related as $E = h\nu$. Where 'h' is Planck's constant.

$$\text{But } \nu = \frac{c}{\lambda}; \therefore E = h\nu = \frac{hc}{\lambda} \rightarrow (2)$$

Equating (1) and (2) and solving for λ .

$$\frac{hc}{\lambda} = V \times q; \lambda = \frac{hc}{Vq}. \text{ Substituting } h = 6.6 \times 10^{-34}$$

J s, we have $c = 3 \times 10^8 \text{ ms}^{-1}$.

$$V = 20 \times 10^3 \text{ V}, q = 1.6 \times 10^{-19} \text{ C}$$

$$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{20 \times 10^3 \times 1.6 \times 10^{-19}} = 0.61875 \text{ Å}.$$

7. What is the mass defect and binding energy of ${}_{27}\text{Co}^{59}$ which has a nucleus of mass of 58.933 u? ($m_p = 1.0078 \text{ u}$, $m_n = 1.0087 \text{ u}$)

☞ **Solution:** In ${}_{27}\text{Co}^{59}$ number of protons = 27.
Number of neutrons = $59 - 27 = 32$.

∴ The total mass of the nucleus = $27 \times 1.0078 \text{ u} + 32 \times 1.0087 \text{ u} = 27.2106 \text{ u} + 32.2784 \text{ u} = 59.489 \text{ u}$.

Given, The actual mass of the nucleus = 58.933 u .

∴ The mass defect = $59.489 \text{ u} - 58.933 \text{ u} = 0.556 \text{ u}$.

∴ The binding energy = $\Delta m \times 931.5 \text{ MeV} = 0.556 \text{ u} \times 931.5 \text{ MeV} = 517.914 \text{ MeV}$.

8. Assuming 200 MeV energy is released per fission of ${}_{92}\text{U}^{235}$, calculate the energy released when 1 kg of ${}_{92}\text{U}^{235}$ undergoes complete fission. What percentage of mass of ${}_{92}\text{U}^{235}$ gets converted into energy?

☞ **Solution:** 235 g of ${}_{92}\text{U}^{235}$ contains Avogadro number (6.023×10^{23}) of atoms.

No. of atoms of ${}_{92}\text{U}^{235}$ in 1 kg of uranium =

$$1000 \times \frac{6.023 \times 10^{23}}{235} = 2.563 \times 10^{24}$$

Energy released = No. of atoms \times energy released per fission.

$$= 2.563 \times 10^{24} \times 200 \text{ MeV} = 5.126 \times 10^{26} \text{ MeV}$$

The mass that liberates the above energy can be calculated using $E = mc^2$... (2)

where $E = 5.126 \times 10^{26} \times 1.6 \times 10^{-13} \text{ J} = 8.2 \times 10^{13} \text{ J}$

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

Substituting in (2), we get $m = \frac{E}{c^2} = \frac{8.2 \times 10^{13}}{9 \times 10^{16}} = 9.11 \times 10^{-4} \text{ kg}$

% of mass = $\frac{9.11 \times 10^{-4}}{1} \times 100 = 0.0911\% = 0.1\%$
approximately

9. Two protons and two neutrons combine to form a nucleus of ${}^4_2\text{He}$. Find the energy released during the process. What type of nuclear reaction is it? Take masses of proton, neutron and helium nucleus as 1.007 u, 1.009 u, 4.002 u respectively.

☞ **Solution:** The nuclear reaction is $2 {}^1_1\text{p} + 2 {}^1_0\text{n} \rightarrow {}^4_2\text{He}$.

First, let us find mass defect and then energy.

The mass of 2p and 2n is $(2 \times 1.007 + 2 \times 1.009)$
 $= 2 \times 2.016 = 4.032 \text{ u}$.

The mass of helium is 4.002 u .

The mass defect = $4.032 - 4.002 = 0.030 \text{ u}$.

1 u liberates 931.5 MeV of energy. The energy equivalent to $0.030 \text{ u} = 0.03 \times 931.5 = 27.94 \text{ MeV}$.

The above nuclear reaction is called fusion as lighter nuclei combine together to form a single nuclei.

10. The binding energy of ${}^7_3\text{Li}$ and ${}^4_2\text{He}$ are 39.2 MeV and 28.24 MeV respectively. Which one of the two nuclei is more stable?

☞ **Solution:** The nucleons present in ${}^7_3\text{Li}$ is 7.

The binding energy per nucleon for lithium is $39.2/7 = 5.6 \text{ MeV}$

The binding per nucleon for helium is $28.24/4 = 7.06 \text{ MeV}$

The binding energy per nucleon is the measure of stability of the nuclei. Therefore, helium is more stable than lithium.

11. A nuclear reactor generates 500 MW electrical energy using the fission of ${}_{92}\text{U}^{235}$. Find the mass of ${}_{92}\text{U}^{235}$ required to produce electricity for 30 days. (0.1% of the mass of ${}_{92}\text{U}^{235}$ gets converted into energy).

☞ **Solution:** The electrical energy produced in one second is 500 MJ. The electrical energy generated in 30 days is $E = 500 \times 60 \times 60 \times 24 \times 30 \times 10^6 = 1.3 \times 10^{15} \text{ J}$. (approximately)

To generate above energy the mass required can be found using the formula $E = mc^2$

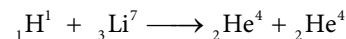
$$\text{or } m = \frac{E}{c^2} = \frac{1.3 \times 10^{15}}{(3 \times 10^8)^2} = 0.144 \times 10^{-1} \text{ kg} \\ = 1.44 \times 10^{-2} \text{ kg}.$$

Let M be the mass of uranium required to generate energy E.

Then 'm' is 0.1% of M.

$$\text{i.e., } m = \frac{0.1}{100} \times M \Rightarrow M = 1000 m \\ = 1000 \times 1.44 \times 10^{-2} = 14.4 \text{ kg}.$$

12. Find the energy released during the following nuclear reaction.



The mass of ${}_3\text{Li}^7$ is 7.0160 u, ${}_2\text{He}^4$ is 4.0026 u and proton is 1.0078 u.

☞ **Solution:** The mass of the reactant nuclei = $7.0160 + 1.0078 = 8.0238 \text{ u}$

The mass of the product nuclei = $4.0026 + 4.0026 = 8.0052 \text{ u}$

Mass defect = $\Delta m = 8.0238 - 8.0052 = 0.0186 \text{ u}$

Energy released = $0.0186 \text{ u} \times 931.5 \text{ MeV}$

$= 17.326 \text{ MeV}$

PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Carbon dating is used to
 - (1) assess the age of fossils.
 - (2) assess the amount of radioactivity.
 - (3) assess the rate of radioactivity.
 - (4) None of the above.
2. The specific charge is the highest for _____.
 - (1) α -rays
 - (2) β -rays
 - (3) protons
 - (4) neutrons
3. Which among the following statements is incorrect about visible light and X-rays?
 - (1) They have same velocity in vacuum or air.
 - (2) They are electromagnetic radiations.
 - (3) They have same wavelength in a given medium.
 - (4) They are not affected by electric field.
4. Which among the following has the lowest speed when travelling through a given medium?
 - (1) γ -rays
 - (2) α -rays
 - (3) β -rays
 - (4) Cathode rays
5. ${}_z\text{P}^A \rightarrow {}_{z-4}\text{D}^{A-16}$
 In the above radioactive reaction, the number of α and β particles emitted are _____ and _____ respectively.
 - (1) 4, 4
 - (2) 6, 6
 - (3) 8, 8
 - (4) 4, 8
6. The mass number of an element in a radioactive series is 223. Which radioactive series is this?
 - (1) $4n + 2$
 - (2) $4n$
 - (3) $4n + 1$
 - (4) $4n + 3$
7. If the half-life period of a radioactive substance is 0.693 years, what is its decay constant?
 - (1) 0.2 year^{-1}
 - (2) 0.1 year^{-1}
 - (3) 0.5 year^{-1}
 - (4) 1 year^{-1}
8. If the binding energy per nucleon for ${}_3\text{Li}^7$ is 5.6 MeV, determine the total binding energy of a lithium nucleus.
 - (1) 139.2 MeV
 - (2) 39.2 MeV
 - (3) 15.8 MeV
 - (4) 115.8 MeV
9. X and Y are two radioactive isobars. Then the daughter nuclei formed after the emission of a β particle from each of them are _____.
 - (1) isosters
 - (2) isotones
 - (3) isobars
 - (4) isotopes
10. A physics student, named Raman, is studying nuclear reactions. He found that ${}_{92}\text{U}^{238}$ nucleus changes to ${}_{91}\text{Pa}^{234}$ nucleus due to radioactive disintegration. Then the number of α and β particles are emitted are _____ and _____ respectively?
 - (1) 1, 1
 - (2) 2, 2
 - (3) 1, 2
 - (4) 2, 1
11. Suresh found that a certain radioactive substance of 10 g reduces to 5 g in 3 hours. From this, he calculated the amount of time required by this radioactive substance to reduce from 80 g to 10 g. The time is _____ hours.
 - (1) 7
 - (2) 6
 - (3) 3
 - (4) 9
12. The half-life period of C^{14} is 5670 years. If 56 g of C^{14} was present initially, how many atoms of C^{14} is left after 22680 years?
 - (1) 1.5×10^{23}
 - (2) 2.9×10^{27}
 - (3) 1.5×10^{27}
 - (4) 2.9×10^{23}
13. How much energy is released when the mass of ${}_8\text{O}^{16}$ nucleus is completely converted into energy? The binding energy per nucleon of ${}_8\text{O}^{16}$ is 7.97 MeV and $m_p = 1.0078 \text{ u}$ and $m_n = 1.0087 \text{ u}$.
 - (1) 14899.438 MeV
 - (2) 148.99 MeV
 - (3) 4489.73 MeV
 - (4) 448.973 MeV
14. Find x in the following nuclear reactions.

$${}_{12}\text{Mg}^{24} + {}_2\text{He}^4 \rightarrow {}_{14}\text{Si}^x + {}_0\text{n}^1$$
 - (1) 17
 - (2) 27
 - (3) 37
 - (4) 24
15. The process of increasing the percentage of fissionable U-235 in naturally occurring uranium is called _____.
 - (1) controlled fission.
 - (2) artificial transmutation.
 - (3) chemical process.
 - (4) enrichment.

16. The nuclear reaction that takes place in a nuclear reactor is _____.
 (1) controlled fission reaction
 (2) uncontrolled fission reaction
 (3) nuclear fusion reaction
 (4) None of the above.
17. What are the different isotopes formed when protons combine to form a ${}^4_2\text{He}$ nucleus?
 (1) ${}_1\text{H}^1, {}_2\text{He}^3$ (2) ${}_2\text{He}^3, {}_2\text{He}^3$
 (3) ${}_1\text{H}^1, {}_1\text{He}^1$ (4) ${}_2\text{H}^3, {}_1\text{H}^2$
18. An α particle is emitted from a heavy radioactive nucleus. If the magnitude of the momenta of the α particle and the daughter nucleus are P_α and P_D which among the following is the correct relation between them?
 (1) $P_\alpha = -P_D$ (2) $P_\alpha > P_D$
 (3) $P_\alpha < P_D$ (4) $P_\alpha = P_D$
19. Mass of ${}_{92}\text{U}^{235}$ required to produce electrical energy in a nuclear reactor for 30 days is 23.5 kg. If 40% of the energy released by the fission is converted into electrical energy, determine the power of the nuclear reactor. (Assume that 200 MeV energy is released per fission of ${}_{92}\text{U}^{235}$)
 (1) 390 MW (2) 297 W
 (3) 297 MW (4) 297MW
20. In the radioactive decay, a ${}_Z\text{X}^A$ nucleus changes to ${}_{Z-1}\text{Y}^{A-4}$ nucleus. How many α and β particles are emitted?
 (1) $1\alpha, 4\beta$ (2) $1\alpha, 1\beta$
 (3) $3\alpha, 4\beta$ (4) $2\alpha, 7\beta$
21. Write down the sequence of radiations emitted in the following radioactive processes.
 ${}_{Z+2}\text{X}^A \rightarrow {}_Z\text{Y}^{A-4} \rightarrow {}_{Z+1}\text{Y}^{A-4} \rightarrow {}_{Z-1}\text{K}^{A-8}$
 (1) $\gamma - \beta - \alpha$ (2) $\gamma - \alpha - \beta$
 (3) $\beta - \gamma - \alpha$ (4) $\alpha - \beta - \gamma$
22. An α -particle is emitted from a stationary ${}_{92}\text{U}^{238}$ nucleus with a velocity of $2.34 \times 10^4 \text{ ms}^{-1}$. Find the recoil velocity of the daughter nucleus.
 (1) -300 ms^{-1} (2) -200 ms^{-1}
 (3) -100 ms^{-1} (4) -400 ms^{-1}
23. An α particle is emitted from a heavy radioactive nucleus. Compare the kinetic energies of the α particle KE_α and the daughter nucleus KE_D .
 (1) $\text{KE}_\alpha > \text{KE}_D$ (2) $\text{KE}_\alpha = \text{KE}_D$
 (3) $\text{KE}_D > \text{KE}_\alpha$ (4) $\text{KE}_\alpha = 4\text{KE}_D$
24. Complete the following reactions.
 ${}_{13}\text{Al}^{27} + \text{_____} \rightarrow {}_{15}\text{P}^{30} + {}_0\text{n}^1$
 (1) α (2) β
 (3) γ (4) ${}_1\text{H}$
25. Find the binding energy per nucleon for lithium nucleus ${}_3\text{Li}^7$. Take mass of ${}_3\text{Li}^7 = 7 \text{ u}$, mass of proton = 1.007825 u and mass of neutron = 1.008665 u . Take $1 \text{ u} = 931.5 \text{ MeV}$.
 (1) 3.7 MeV (2) 4.9 MeV
 (3) 1.7 MeV (4) 7.736 MeV
26. The conditions for the discharge of electricity in a discharge tube are _____.
 (1) high temperature and high potential
 (2) low pressure and high potential
 (3) low pressure and high temperature
 (4) low potential and high pressure
27. The lamp whose working is based on a discharge tube is _____.
 (1) fluorescent lamp
 (2) incandescent lamp
 (3) CFL
 (4) Both (1) and (3)
28. A light paddle wheel placed in the path of _____ will rotate.
 (1) cathode rays
 (2) α -rays
 (3) β -rays
 (4) All the above
29. A modified discharge tube is used as _____.
 (1) cathode ray oscilloscope
 (2) fluorescent tube
 (3) X-ray tube
 (4) All the above
30. The emission of 'weak X-rays' from uranium salts discovered by Becquerel could _____.
 (1) ionize gases
 (2) affect photographic plates
 (3) penetrate through matter
 (4) All the above
31. X-rays are produced by impinging _____ on a target.
 (1) α particles
 (2) protons
 (3) electrons
 (4) X-rays

32. _____ are useful in studying the crystal structures.
- (1) All electromagnetic radiations
 - (2) Light rays
 - (3) X-rays
 - (4) γ -rays
33. The total electric charge on a certain number of electrons is found to be 96368 C. What is the mass of these electrons?
- (1) 0.5 kg
 - (2) 50 g
 - (3) 0.55 mg
 - (4) 5 mg
34. In plants and animals, the ratio of C^{14} to C^{12} is _____.
- (1) $10^{-12} : 1$
 - (2) $1 : 10^{-12}$
 - (3) $1 : 10^{-10}$
 - (4) $10^{-10} : 1$
35. Find x in the following nuclear reactions
- $${}_2\text{He}^4 + {}_{13}\text{Al}^{27} \rightarrow {}_x\text{P}^{30} + {}_0\text{n}^1.$$
- (1) 14
 - (2) 13
 - (3) 15
 - (4) 11

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The common product formed in the artificial transmutation by a proton is _____.
 - (1) helium
 - (2) hydrogen
 - (3) photon
 - (4) neutron
2. Even when no radioactive substances are present near a Geiger counter always shows a reading. This is due to the presence of _____ radiations.
 - (1) cosmic
 - (2) background
 - (3) light
 - (4) radio
3. The radioactive isotope used in the treatment of cancer is a good source of _____ radiations.
 - (1) β
 - (2) α
 - (3) γ
 - (4) IR
4. A radioactive isotope of radium placed in the second group in the periodic table emits one α -particle and one β -particle. The new element formed is in the _____ group.
 - (1) first
 - (2) second
 - (3) third
 - (4) fourth
5. Which of the following radiations has the highest penetrating power?
 - (1) α
 - (2) β
 - (3) γ
 - (4) X-rays
6. The property of cathode rays used in a monitor of a computer is _____.
 - (1) high velocity
 - (2) high ionization power
 - (3) to cause fluorescence by phosphorus
 - (4) rectilinear propagation
7. Higher value of decay constant indicates _____.
 - (1) faster decay
 - (2) high half-life period
 - (3) slower decay
 - (4) Both (1) and (2)
8. Using $E = mc^2$, find out the energy released, when 2 u of mass is destroyed completely.
Take $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$.
 - (1) 4.65 MeV
 - (2) 3627 MeV
 - (3) 91.5 MeV
 - (4) 1865 MeV
9. A radioactive substance was reduced to 1/4 of the total amount in 8 days. Determine the further time taken by this radioactive substance to get reduced to $1/8^{\text{th}}$ of the remaining amount.
 - (1) 18 days
 - (2) 12 days
 - (3) 24 days
 - (4) 6 days
10. Complete the reaction: ${}_{86}\text{Rn}^{220} \rightarrow {}_{84}\text{Po}^{216} + \text{_____}$
 - (1) β
 - (2) γ
 - (3) α
 - (4) H_1^1
11. A multi-speciality medical lab bought a radioactive isotope which has a half-life of 3 hours. When it is brought to lab, Dinakar, a research scholar found that it contained 1.024×10^{23} atoms. With this information he found out how many atoms were left after 30 hours. Find the number of atoms that were left undisintegrated.
 - (1) 10^{30}
 - (2) 10^{20}
 - (3) 10^{10}
 - (4) 10^5

12. 15/16th of a radioactive substance disintegrates in 12 days. How much more time will it take for the remaining amount of radioactive substance to reduce to 1/32 of the reduced amount? What is the half-life period of the radioactive substance?
- (1) 40 days, 3 days (2) 30 days, 3 days
(3) 15 days, 3 days (4) 5 days, 2 days
13. The binding energy per nucleon for deuterium and helium is 1.1 MeV and 7 MeV respectively. Find how much energy is released by the fusion of 1g of deuterium.
- (1) 5.68×10^{11} J (2) 1.72×10^7 J
(3) 9.68×10^5 J (4) 5.68×10^3 J
14. Katen was studying about nuclear physics. There, he collected values of binding energies of ${}_1\text{H}^2$, ${}_2\text{He}^4$, ${}_{26}\text{Fe}^{56}$ and ${}_{92}\text{U}^{235}$ and they are 2.22 MeV, 28.3 MeV, 492 MeV and 1786 MeV respectively. Then, he got a doubt that stability of the nucleus depends on its binding energy which among the above four is the most stable nucleus?
- (1) He_2^4 (2) U_{92}^{235}
(3) ${}_1\text{H}^2$ (4) ${}_{26}\text{Fe}^{56}$
15. Write down the sequence of radiations emitted in the following radioactive processes.
- $${}_{Z+1}\text{X}^A \rightarrow {}_{Z-1}\text{Y}^{A-4} \rightarrow {}_{Z-1}\text{Y}^{A-4} \rightarrow {}_Z\text{K}^{A-4}$$
- (1) $\alpha - \gamma - \beta$ (2) $\alpha - \beta - \gamma$
(3) $\gamma - \beta - \alpha$ (4) $\beta - \gamma - \mu$
16. Find x in the following nuclear reactions.
- $${}_7\text{N}^{14} + {}_2\text{He}^4 \rightarrow {}_x\text{O}^{17} + {}_1\text{H}^1$$
- (1) 6 (2) 8
(3) 9 (4) 7
17. Find x in the following nuclear reactions.
- $${}_{92}\text{U}^{236} \rightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^x + 3{}_0\text{n}^1 + \text{Q}$$
- (1) 93 (2) 94
(3) 92 (4) 90
18. Which of the following are used as a nuclear fuel?
- (1) ${}_{82}\text{Pb}^{208}$ (2) ${}_{92}\text{U}^{235}$
(3) ${}_{92}\text{U}^{238}$ (4) Both (2) and (3)
19. How many grams of U^{235} is required to produce 8×10^{11} J of energy, if 200 MeV of energy is released when one U^{235} atom undergoes fission?
- (1) 39.54 g (2) 9.754 g
(3) 19.51 g (4) 49.754 g
20. Determine the energy released during the fusion of ${}_1\text{H}^1$ to form a ${}_2\text{He}^4$ nucleus, if the total mass of the products is 4.001506 u, mass of proton is 1.0078u and mass of neutron is 1.0087u.
- (1) 27.67 MeV (2) 27.67 J
(3) 127.67 J (4) 127.67 MeV
21. Sikar read that when ${}_{92}\text{U}^{235}$ undergoes fission, approximately 0.1% of its original mass changes into energy. With this information, calculate the amount of energy released when 1 kg of ${}_{92}\text{U}^{235}$ undergoes fission.
- (1) 9×10^{13} J (2) 119×10^{13} J
(3) 99×10^{13} J (4) 177×10^{13} J
22. Write down the sequence of radiations emitted in the following radioactive processes.
- $${}_Z\text{X}^A \rightarrow {}_Z\text{P}^A \rightarrow {}_{Z-2}\text{Y}^{A-4} \rightarrow {}_{Z-1}\text{Y}^{A-4}$$
- (1) $\alpha - \gamma - \beta$ (2) $\beta - \gamma - \alpha$
(3) $\gamma - \alpha - \beta$ (4) $\alpha - \beta - \gamma$
23. How many nuclei of ${}_{92}\text{U}^{235}$ should undergo fission per second, to produce a power of 10 MW, if 200 MeV of energy is released per fission of ${}_{92}\text{U}^{235}$?
- (1) 3.12500 (2) 3.125×10^7
(3) 3.125×10^{17} (4) 3.125×10^{27}
24. How many α and β particles are emitted when ${}_{92}\text{U}^{238}$ disintegrates to form lead ${}_{82}\text{Pb}^{206}$?
- (1) 4 α , 2 β (2) 3 α , 16 β
(3) 8 α , 6 β (4) 8 α , 26 β
25. If 20% of a radioactive substance decays in 5 days, then find the approximate percentage of initial amount left after 20 days.
- (1) 41% (2) 82%
(3) 39% (4) 59%
26. Complete the following reactions.
- $${}_7\text{N}^{14} + {}_0\text{n}^1 \rightarrow \text{_____} + {}_1\text{H}^1$$
- (1) ${}_7\text{N}^{14}$ (2) ${}_7\text{N}^{14}$
(3) ${}_6\text{C}^{12}$ (4) ${}_6\text{C}^{14}$
27. Complete the following reactions.
- $${}_3\text{Li}^7 + {}_1\text{H}^1 \rightarrow 2 \text{_____}$$
- (1) ${}_1\text{H}^2$ (2) He_2^3
(3) He_2^4 (4) He_1^3
28. The high temperature required to initiate the nuclear fusion reaction is to overcome _____.
- (1) electric force (2) electrostatic force
(3) gravitational force (4) magnetic force

29. The fluorescence of the glass (discharge) tube at very low pressure is characteristic of _____.
 (1) the phosphors in the material of the glass
 (2) the gas used in the tube
 (3) the cathode
 (4) All the above
30. Cathode ray particles have a mass of _____ times that of hydrogen nucleus.
 (1) 1 (2) $\frac{1}{10}$
 (3) 1840 (4) $\frac{1}{1840}$
31. When cathode rays moving horizontally pass through an electric field directed vertically downward, the rays would deflect _____.
 (1) downward (2) upward
 (3) backward (4) None of the above
32. The target used in a Coolidge tube for the production of X-rays is made up of _____.
 (1) manganese (2) molybdenum
 (3) uranium (4) radium
33. The radiations from uranium discovered by Becquerel are _____.
 (1) γ -rays
 (2) X-rays
 (3) cathode rays
 (4) canal rays
34. When a charged particle of charge x C moves through a potential difference of y V the gain in kinetic energy is equal to xy J.
 An electron and an alpha particle have their masses in the ratio of 1:7200 and charges in the ratio of 1:2. If they start moving from rest through the same electrical potential difference then the ratio of their velocities is _____.
 (1) 1 : 60 (2) 60 : 1
 (3) 1 : 20 (4) 20 : 1
35. The study of radiations involving X- rays were carried out by _____.
 (1) Henri Becquerel
 (2) William Roentgen
 (3) Marie and Pierre Curie
 (4) All the above

ANSWER KEYS

PRACTICE EXERCISE 9 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 2 | 5. 1 | 6. 4 | 7. 4 | 8. 2 | 9. 3 | 10. 1 |
| 11. 4 | 12. 1 | 13. 1 | 14. 2 | 15. 4 | 16. 1 | 17. 1 | 18. 1 | 19. 3 | 20. 2 |
| 21. 3 | 22. 4 | 23. 1 | 24. 1 | 25. 4 | 26. 2 | 27. 4 | 28. 4 | 29. 4 | 30. 4 |
| 31. 3 | 32. 3 | 33. 3 | 34. 1 | 35. 3 | | | | | |

PRACTICE EXERCISE 9 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 1 | 5. 3 | 6. 3 | 7. 1 | 8. 4 | 9. 2 | 10. 3 |
| 11. 2 | 12. 3 | 13. 1 | 14. 4 | 15. 1 | 16. 2 | 17. 3 | 18. 4 | 19. 2 | 20. 1 |
| 21. 1 | 22. 3 | 23. 3 | 24. 3 | 25. 1 | 26. 4 | 27. 3 | 28. 2 | 29. 1 | 30. 4 |
| 31. 2 | 32. 2 | 33. 1 | 34. 2 | 35. 4 | | | | | |

Electronics

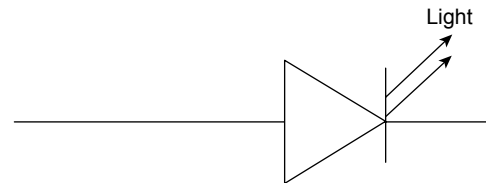
SYNOPSIS

- Electronics is a branch of applied physics which deals with controlled motion of charged particles.
- The branch of electronics which deals with vacuum tubes is called tube electronics.
- The electrical conduction in solids takes place due to the drift of electrons through them. In liquids electrical conduction takes place through motion of ions; in gases the conduction takes place only at a low pressure.
- The electrons that are emitted from the surface of the cathode in a vacuum tube are called free electrons.
- On supplying energy to the cathode of the vacuum tube, free electrons are emitted from its surface.
- The energy to be supplied to the loosely bound electrons of the cathode to make them free, can be in the form of heat, light or high energy ultra violet radiation or X-ray radiation.
- If the energy supplied is in the form of heat, the phenomenon of electron emission is called **thermionic emission**.
- Thermionic emission is defined as “the phenomenon in which free electrons are emitted from a metallic surface, by the absorption of heat energy supplied to them”.
- For a given metallic surface, there exists a minimum heat energy required for a thermion to be liberated and this minimum heat energy is called ‘**threshold energy**’ or ‘**work function**’.
- The threshold energy or work function is usually measured in electron-volts (eV).
- The rate of emission of thermions depends on the nature of the metallic surface.
- Thus the rate of emission of thermions is inversely proportional to the work function of metals.
- The rate of thermionic emission is directly proportional to the square of the absolute temperature of the cathode.
- The rate of thermionic emission is directly proportional to the surface area of the cathode.
- Thermionic emitters can be broadly classified into two categories. They are directly heated thermionic emitters and indirectly heated thermionic emitters.
- A diode valve is an electronic device that consists of two electrodes and is used to allow the flow of electrons in a circuit in a particular direction.
- There are two types of diode valves, one that contains a directly heated thermionic emitter and the other that contains an indirectly heated thermionic emitter.
- A cathode ray oscilloscope (CRO) or a cathode ray tube (CRT) is a device that converts electrical signals into visual signals.
- Solids are classified into conductors, insulators and semiconductors based on their energy bands.

- Energy band structure of conductors are of two types.
- In the first type, the conduction band and valence band are separated by a very small gap.
- In the second type, the valence band and the conduction band overlap. Hence there is no forbidden energy gap.
- In insulators, the valence band and the conduction band are separated by a large energy gap (E_g). The valence band is completely filled and the conduction band is completely empty.
- In semiconductors, the valence band and the conduction band are separated by a small forbidden energy gap.
- Semiconductors are classified into intrinsic semiconductors or pure semiconductors and extrinsic semiconductors or impure semiconductors.
- A semiconductor in the purest form is called an intrinsic semiconductor.
- When an electron moves from valence band to conduction band a vacant site is created in the valence band and this vacant site behaves as net positive charge of magnitude $+e$. This vacant site is called hole.
- For every electron released, a hole is formed. Thus the number of electrons is equal to the number of holes in an intrinsic semiconductor.
- When potential difference is applied, the holes move in a direction opposite to that of electrons. Hence there are two types of charge carries in a semiconductor.
- The process of adding impurities to a pure semiconductor is called doping and the impurity added to a pure semiconductor is called dopant.
- Extrinsic semiconductors are classified into two types namely n-type semiconductor and p-type semiconductor.
- If a pentavalent impurity like arsenic, antimony, or phosphorus etc., is added to molten silicon or germanium, during the process of crystal growth, an n-type semiconductor is obtained.
- In an n-type semiconductor majority charge carriers are electrons and minority charge carriers are holes.
- If a trivalent impurity like indium, boron or gallium is added to molten silicon or germanium, during the crystal growth, a p-type semiconductor is obtained.
- In p-type semiconductor majority charge carriers are holes and minority charge carriers are electrons.
- p-n junction is a junction between a p-type and n-type semiconductor such that it is continuous at the boundary.
- When the p-side of a p-n junction is connected to the positive terminal of a battery and n-side is connected to

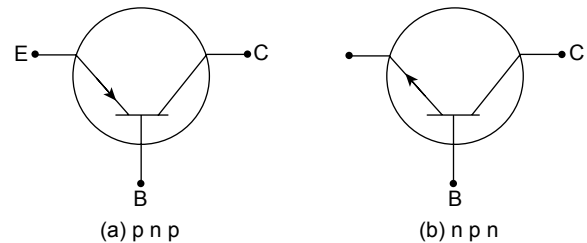
the negative terminal of the battery or the applied source, then the p-n junction is said to be forward biased.

- When p-side of a p-n junction is connected to the negative terminal of a battery and n-side is connected to the positive terminal of the battery, then the p-n junction is said to be reverse biased.
- Rectifier is a device which converts AC into DC. The process of converting AC to DC is called rectification.
- LED's are p-n junction diodes which emit light when the diode is forward biased.
- LEDs are used in display in various systems such as calculators, stereo amplifiers, digital clocks, etc.
- LEDs emitting radiation in infrared region is used in burglar alarms, CD players, etc.
- Liquid crystal is a state of matter which has property of both solid and liquid.
- Liquid crystals are used in liquid crystal thermometer, TV and computer monitors.
- Transistor was invented by J.Bardeen and W.H. Bart-tain and modern transistor was invented by William Shockley.



Schematic diagram of LED

- Transistor is a three terminal and two p-n junction device. In this device, transfer of resistance takes place, hence this device is called as transfer resistor or transistor.



- It is a device which strengthens weak AC signals. The process of strengthening weak signal is known as amplification.
- In the broadcasting of radio and television programmes, electromagnetic waves in the frequency range of radio frequency are utilised.
- Transducer is a device which converts audio or video information into electrical signal.

- Microphone is used as a transducer for sound transmission and photoelectric device is used as a transducer for video transmission.
- For radio transmission, the radio frequency (RF) is in the range of 300 kHz to 30 MHz and for television it is in the range of 30 MHz to 300 MHz.
- The process of superposing a message signal onto a radio frequency wave is known as 'modulation'.
- In modulation, there are two types, namely, 'amplitude modulation' (AM) and 'frequency modulation' (FM).
- This process of extracting message signals from a modulated radio frequency carrier waves is known as 'demodulation' or 'detection'.
- Integrated circuit is a single semiconductor crystal or a chip which can perform the operation of resistor, capacitor, diodes and transistors in various combinations.
- Combination of many ICs is called microprocessor. A microprocessor can compute data, make logical decisions and store data.
- Computer is a device that helps in computing.
- The information that is fed to the computer is known as input.
- CPU is the central processing unit. It is the most important part of a computer and thus is generally referred to as the heart of it. This unit comprises three sub units. They are control unit (CU), Memory unit (MU) and Arithmetic Logic Unit (ALU).
- The processed information is the result and is given out to the user. It is called the output. The devices through which output is obtained are called the output devices. Monitor, printer, etc., are the output devices.
- A computer cannot perceive the information in the form that we understand, as it uses a binary system.

Solved Examples

1. P and Q are oppositely charged metal plates held parallel to each other and a thermion beam passes in the space between P and Q. If P is positively charged and Q is negatively charged then how does the thermion beam deflect? Why? Why is a tungsten filament coated with alkali metal oxides considered a good thermion emitter?

☞ **Solution:** As thermions are negatively charged particles, they will deflect towards the plate P, which is positively charged because of attraction. The work function of alkali metal oxides is very less (less than one eV). It starts emitting electrons at a temperature of 1000 K. Hence, tungsten coated with alkali metal oxides is considered as good thermionic emitter.

2. In a cathode ray tube, if the cathode plate is connected to the positive terminal of HT instead of the negative terminal of HT will the thermionic emission occur?

☞ **Solution:** In a cathode ray tube, if the cathode plate is connected to positive terminal of HT battery, the thermionic emission occurs. But the emitted electrons gets repelled by the anode and only some electrons reach the screen.

3. What is the effect on the thermion beam in a cathode ray tube if the anode voltage value is reduced but remains above zero?

☞ **Solution:** If the anode voltage is reduced in a cathode ray tube, the emitted electrons are less attracted and accelerated and if the rate of attraction of electrons is less than the rate of emission of electrons, then a space charge will develop around the cathode.

4. (a) Can we use a screen coated with barium platinocyanide in a cathode ray tube?
(b) If so what effects do we observe on the screen?

☞ **Solution:** (a) Yes, it is a fluorescent material and can be coated on the screen to produce fluorescence when thermions strike it.

(b) We observe that the screen glows with bluish white glow.

5. There are a large number of free electrons moving randomly in a metal. At room temperature, why do they not come out of the surface of metal?

☞ **Solution:** In a metals like copper or tungsten, there are plenty of free electrons. At room temperature these electrons wander randomly in the atomic structure, but they cannot leave the metallic surface. At room temperature ordinary metals do not loose their electrons. This means that a force must exist, which prevents electrons from leaving the metallic surface permanently. To understand what this force is and how it is created, let us assume that due to its random

motion, an electron leaves the surface. Immediately after it leaves the surface, the metal gains a positive charge (losing a negatively charged electron is equivalent to gaining a positive charge). This positive charge exerts a force of attraction on the emitted electron. This force pulls the electron back to the metal. For an electron to escape from the metal surface, it must have sufficient kinetic energy to overcome this force. This force is described as surface barrier.

6. Even though the p-type and n-type semiconductors have holes and electrons respectively as majority charge carriers, why are they electrically neutral? Explain.

☞ **Solution:** The p-type and n-type semiconductors are formed when the impurity atoms, which themselves are electrically neutral, are added to pure semiconductor which is also electrically neutral. Hence the p or n type semiconductor formed is electrically neutral. The letter p in p-type semiconductor indicates the majority charge carriers and not the net charge in the semiconductor.

7. In an oscilloscope, the cathode emits the electrons which are accelerated by the anodes. Explain the kind of voltages to be applied to the horizontal and vertical plates so that images formed on the deflecting screen are

(a) horizontal line (b) vertical line

☞ **Solution:** (a) To get horizontal line on the screen, an AC voltage should be applied to the vertical deflecting plate and no voltage should be applied on horizontal deflecting plates.

(b) To get vertical line, an AC voltage should be applied to the horizontal deflecting plate and no voltage on the vertical plates

8. In the following circuit diagram, what is the resistance between A and B when the current flows from A to B and from B to A? (Assume the diode is an ideal diode with no barrier potential and bias resistance)

☞ **Solution:** The resistance of the circuit depends on the potential of A with respect to B. If the potential of A is greater than the potential of B, then the diode is forward biased.

In this case, the resistance between A and B becomes,

$$\frac{20 \times 20}{20 + 20} = \frac{20 \times 20}{40} = 10 \Omega$$

When current flows from B to A the diode is in reverse bias and no current flows through the part of the circuit in which diode is connected. Hence the effective resistance is 20Ω

9. In what respect an LED different from an ordinary PN – junction diode? Where should we prefer LEDs over ordinary incandescent lamps? Why?

☞ **Solution:** When a P-N junction diode is forward-biased the potential barrier is lowered. The majority carriers start crossing the junction. The conduction band electrons from the N region cross the barrier and enter the P region. Immediately on entering the P region each electron falls into a hole and recombination takes place.

Each recombination radiates energy in an ordinary diode (power diode or signal diode). The radiated energy is in the form of heat. In the light-emitting diode (LED), the radiated energy is in the form of light (or photons):

LEDs are used in traffic signals, TV etc.

LEDs have number of advantages over ordinary incandescent lamps. They work on low voltage (1 or 2 V) and currents (5 to 10 mA) and thus consume less power. They require no heating, no warm-up time, and hence they are very fast in action. They are small in size and light in weight. They are not affected by mechanical vibrations, and have long life (more than 20 years).

10. What is a transistor? Why is it so called? What are the advantages of transistors over vacuum tubes?

☞ **Solution:** Transistor means transfer of a signal across a resistor. It is a semiconductor device. It can produce electrical oscillations, amplify small alternating currents and produce rectification. Transistor is an efficient substitute for thermionic valves.

Advantages of transistors over thermionic tubes.

- (i) Transistors are very small in size while valves are large in size.
- (ii) Transistor do not require heating while valves required to be heated.
- (iii) Transistor consumes only small power while valve consumes large power.
- (iv) Transistors have long life periods.
- (v) The response time of transistors is very small.
- (vi) Valves require warming up time.

PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. In a vacuum diode, 2×10^{19} electrons emitted from the cathode reach the plate of a vacuum diode in 4 seconds. Find the current and the power consumed if the PD between the cathode and the plate is 200 V.
 - (1) 0.8 A, 160 W (2) 0.8 A, 16 W
 - (3) 0.8 A, 1.6 W (4) 0.8 A, 1600 W
2. The characteristics which a material should possess to act as a good thermionic emitter is _____.
 - (1) high work function and high melting point
 - (2) high work function and low melting point
 - (3) low work function and high melting point
 - (4) low work function and low melting point
3. An oscilloscope is basically designed to convert _____.
 - (1) visual signals to electrical signals
 - (2) sound signals to electrical signals
 - (3) electrical signals to visual signals
 - (4) sound signals to visual signals
4. The free electrons that are emitted from a metal surface, when heat energy is supplied are called _____.
 - (1) positions (2) thermions
 - (3) electrons (4) photons
5. Thermionic emitters can be classified into _____ and _____.
 - (1) Direct LED and indirect LED
 - (2) Direct transistor and indirect transistor
 - (3) directly heated thermionic emitter and indirectly heated thermionic emitter
 - (4) Directly heated emitter and indirectly heated emitter
6. Electrons emitted from the surface of a cathode have sufficient kinetic energy to reach the anode even if the anode is at a negative potential. In a vacuum diode, no current flows when the anode potential is less than -5 V. Find the maximum kinetic energy of the electrons in electron volts, emitted from the cathode surface.
 - (1) 5 eV (2) 10 eV
 - (3) 5 MeV (4) 10 MeV
7. Bands in solids are formed due to a group of closely spaced _____.
 - (1) conductor bands (2) valance bands
 - (3) energy levels (4) solid bands
8. The depletion region in a semiconductor diode is formed at the _____.
 - (1) thermionic emitter (2) junction diode
 - (3) diode (4) forbidden diode
9. In a reverse biased p-n junction diode, the p-type semiconductor is connected to _____ terminal of the cell and n-type to the _____ terminal of the cell.
 - (1) positive, positive (2) negative, negative
 - (3) positive, negative (4) negative, positive
10. A pure germanium crystal at absolute zero is
 - (1) an insulator (2) a good conductor
 - (3) a semiconductor (4) None of the above
11. A pure semiconductor at absolute zero has
 - (1) absence of electrons in the conduction band.
 - (2) all the electrons occupying the valence band.
 - (3) large E_g value.
 - (4) All of the above
12. The energy gap in glass at room temperature is
 - (1) greater than that in a semiconductor.
 - (2) less than that in a good conductor.
 - (3) greater than that in a good conductor.
 - (4) Both (1) and (3) are true
13. The resistivity of an intrinsic semiconductor
 - (1) increases with an increase in temperature.
 - (2) decreases with an increase in temperature.
 - (3) is independent of temperature.
 - (4) increases upto a certain temperature and thereafter remains constant.
14. The forbidden gap for a pure silicon at the room temperature is _____ eV.
 - (1) less than one (2) 1.1
 - (3) 3 (4) 9
15. In a semiconductor, holes are present only in the _____.
 - (1) conduction band (2) valence band
 - (3) forbidden gap (4) All of the above

16. In an intrinsic semiconductor, if N_c is the number of electrons in the conduction band and N_p is the number of holes in the valence band then

(1) $N_c > N_p$ (2) $N_c = N_p$
 (3) $N_c < N_p$ (4) None of the above.

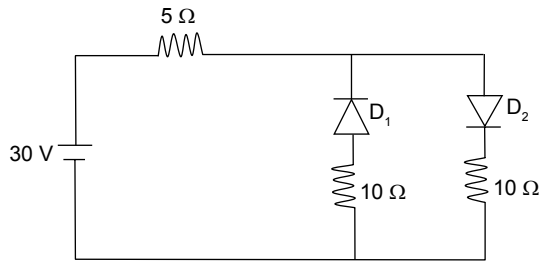
17. To make n-type semiconductor, an intrinsic semiconductor is doped with _____.

(1) gallium (2) indium
 (3) boron (4) arsenic

18. A junction transistor does not have _____.

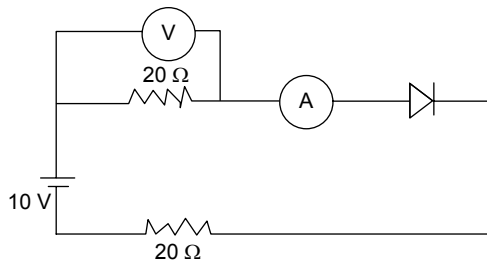
(1) emitter-base junction
 (2) base-collector junction
 (3) emitter-collector junction
 (4) None of the above.

19. Calculate the current through the given circuit. (The diodes are ideal)



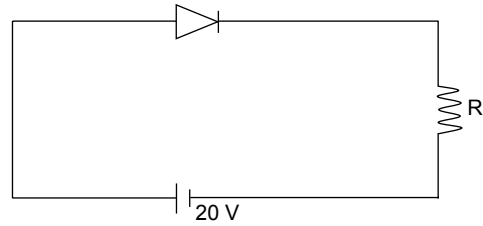
(1) 6 A (2) 12 A
 (3) 1 A (4) 2 A

20. In the following circuit diagram, what are the values recorded by the ammeter and the voltmeter if the potential across the diode is 1 V?



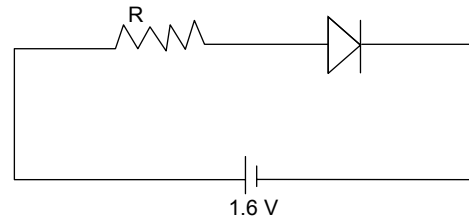
(1) 4.5 V (2) 5 V
 (3) 4 V (4) 5.4 V

21. The silicon diode shown in figure is rated for a maximum current of 100 mA. Calculate the minimum value of the resistance of the resistor R. Assume the forward voltage drop across the diode to be 0.7 V.



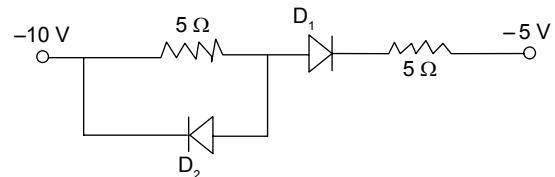
(1) 70 Ω (2) 16 Ω
 (3) 193 Ω (4) 39 Ω

22. The diode used in the circuit shown below has a constant voltage drop of 0.6 V at all currents and a maximum power rating of 300 milli watt. What should be the value of the resistance R, if the maximum current passes through the diode?



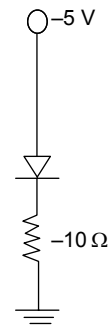
(1) 4 Ω (2) 2 Ω
 (3) 1 Ω (4) 32 Ω

23. In each of the following circuit diagrams, identify which diode (diodes) is (are) forward biased.



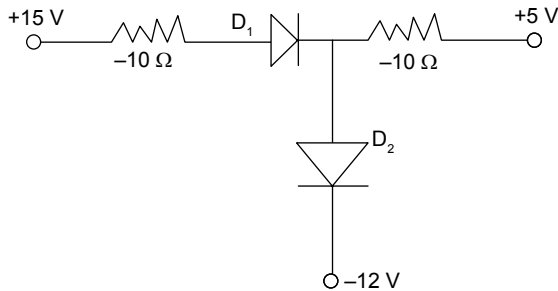
(1) Only D_2 (2) Only D_1
 (3) Both D_1 and D_2 (4) Neither D_1 nor D_2

24. In the following circuit diagram,



- (1) the diode is forward biased
- (2) the diode is reverse biased
- (3) Current due to majority charge carriers flows from A to B
- (4) Current due to majority charge carriers flows from B to A

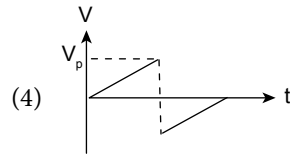
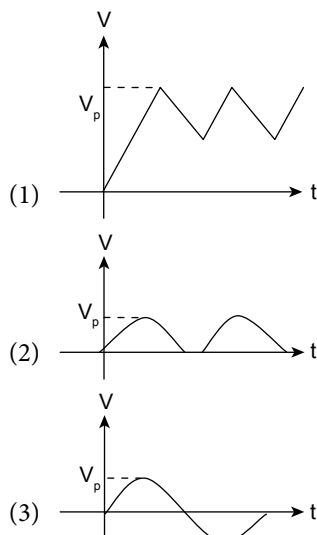
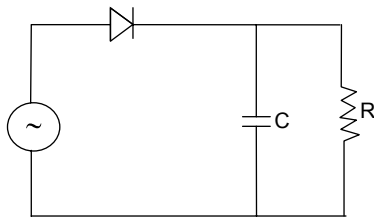
25.



In the above circuit diagram, identify diode (diodes) which is (are) forward biased.

- (1) Only D_1
- (2) Only D_2
- (3) Both D_1 and D_2
- (4) Neither D_1 nor D_2

26. In the circuit diagram, which among the following graph shows the voltage across R. The sinusoidal voltage has a peak value of 200 V and the capacitor used has long charging time. Assume the diode to be an ideal diode.



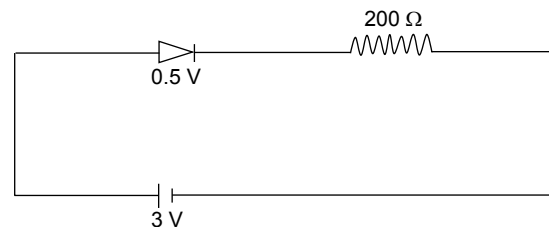
27. _____, _____ and memory unit constitute the CPU of a computer.

- (1) Compiler, Mother board
- (2) ALU, Control unit
- (3) ALU, RAM
- (4) ALU, ROM

28. In a computer, _____ can perform mathematical operations, understand instructions given to it and take logical decisions.

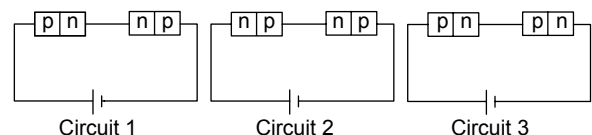
- (1) ALU
- (2) Keyboard
- (3) Monitor
- (4) Mouse

29. Determine the current flowing through the circuit shown below.



- (1) 15 mA
- (2) 12.5 mA
- (3) 25 mA
- (4) 50 mA

30. Two identical p-n junctions may be connected in series with a battery in three different ways as shown in the circuit diagrams. In which circuit diagram will the potential drop across the p-n junctions be equal?



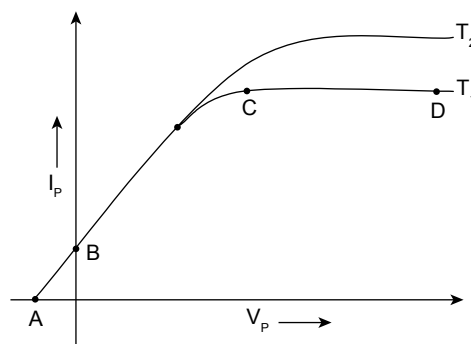
- (1) Circuit (1)
- (2) Circuit (2)
- (3) Circuit (3)
- (4) Circuit (2) and (3)

PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- Which among the following is an example of semiconductor?
 - Cuprous oxide
 - Iron
 - Copper
 - Aluminium
- In a CRO the acceleration of electrons is controlled by changing _____ between the cathode and anode.
 - Potential difference
 - Space
 - temperature
 - None of these
- The subatomic particle that is emitted from a metal surface, when it is heated is _____.
 - proton
 - electron
 - positron
 - nertron
- In a vacuum diode, the space around the cathode which is filled with electrons, is called _____.
 - space charge
 - electric field
 - magnetic field
 - electron cloud
- The minimum heat energy required to emit an electron from the surface of a metal is called _____.
 - electron volt
 - work function
 - thermal radiation
 - UV rays
- The band structure determines the _____ behaviour of a solid.
 - chemical
 - electrical
 - mechanical
 - molecular
- A graph of vacuum diode current I_p is plotted against the anode voltage V_p for two different temperatures T_1 and T_2 of the cathode, as shown in the figure below. Study the graph and answer the following questions.

For the same anode voltage, (called plate voltage), the current more when the cathode temperature changes from T_1 to T_2 , higher temperature



- More number of electron undergo collision
 - more electrons are emitted
 - resistance increases
 - voltage increases
- In a vacuum diode, some of the electrons possessing sufficient kinetic energy can reach the plate even if the plate potential is negative. For a certain diode, the plate current becomes zero when plate potential is -10 V. What is the kinetic energy of the electrons in eV, if the plate potential is -4 V?
 - 3 eV
 - 6 eV
 - 4 eV
 - -4 eV
 - Energy band at higher level is called _____.
 - Valance band
 - energy gap
 - conduction band
 - energy band
 - In a/an _____, the valence band and conduction band overlap each other.
 - insulator
 - semiconductor
 - conductor
 - super conductor
 - The vacancy created due to the absence of an electron in the valence band of a semiconductor is called _____.
 - electron
 - hole
 - proton
 - position
 - When an intrinsic semiconductor is connected to an electric cell, the holes move towards the _____ terminal of the cell.
 - holes, negative positive
 - electron, negative
 - electrons positive
 - both (1) and (3)

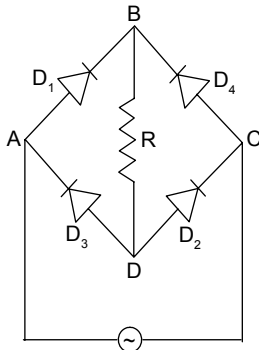
13. A doped intrinsic semiconductor is called an _____ semiconductor.

- (1) intrinsic
- (2) extrinsic
- (3) doped semiconductor
- (4) active semi conductor

14. The region close to the p-n junction which is depleted of mobile charge carriers is called _____ region.

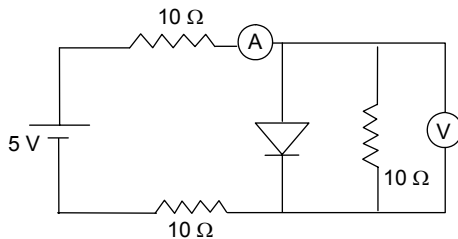
- (1) depletion
- (2) active
- (3) inactive
- (4) resistive

15. The following circuit acts as a _____



- (1) half wave rectifier
- (2) amplifier
- (3) full wave rectifier
- (4) oscillator

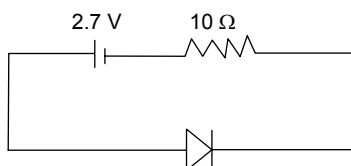
16. In the following circuit diagram, if the diode is ideal, what are the values recorded by the ammeter and the voltmeter?



- (1) Zero
- (2) 0.25 A
- (3) 0.5
- (4) 0.75

17. Find the energy dissipated in 10 minutes in the diode in the circuit shown below.

The barrier potential across a diode is 0.7 V which remains constant. (Assume the diode to be ideal)



- (1) 32 J
- (2) 24 J
- (3) 84 J
- (4) 64 J

18. Which among the following is the wave length used for television transmission?

- (1) 500 KHz
- (2) 100 KHz
- (3) 200 MHz
- (4) 400 MHz

19. A computer program that converts high level language instructions into machine language instructions is _____.

- (1) BASIC
- (2) FORTRAN
- (3) COBOL
- (4) Compiler

20. Control unit, arithmetic and logic unit and memory unit of a computer constitute _____.

- (1) CPU
- (2) software
- (3) monitor
- (4) machine language

21. The binary equivalent of 7 is _____.

- (1) 0100
- (2) 0101
- (3) 0111
- (4) 1000

22. A group of 8 bits is called a _____.

- (1) binary digits
- (2) byte
- (3) word
- (4) binary number

23. A computer program is the group of _____ given to the computer.

- (1) words
- (2) letters
- (3) instructions
- (4) numbers

24. In a n-p-n transistor circuit, the collector current is 9.9 mA. If 90% of the electrons emitted reach the collector, find out the value of emitter current and base current.

- (1) 1.1 mA
- (2) 2.2 mA
- (3) 9.9 mA
- (4) 8.8 mA

25. Compiler is a computer program that converts

- (1) machine language instructions to high level language instructions.
- (2) high level language instructions into machine language instructions.
- (3) Basic language to Fortran language.
- (4) Fortran language to Basic language.

26. In the BCD system, the zone bit of number 9 is _____

- (1) 1010
- (2) 0101
- (3) 0010
- (4) 1011

27. 28×10^{15} electrons reach the anode of a vacuum tube per second. If the power consumed is 896 milli watts. What is the anode voltage?

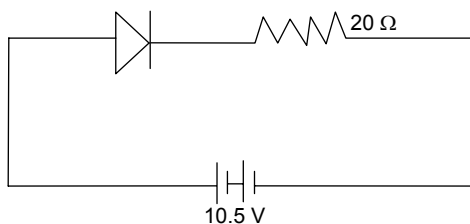
- (1) 100 V (2) 200 V
(3) 300 V (4) 400 V

28. Find out the current in the circuits shown below. (The diodes used in the circuits are ideal)



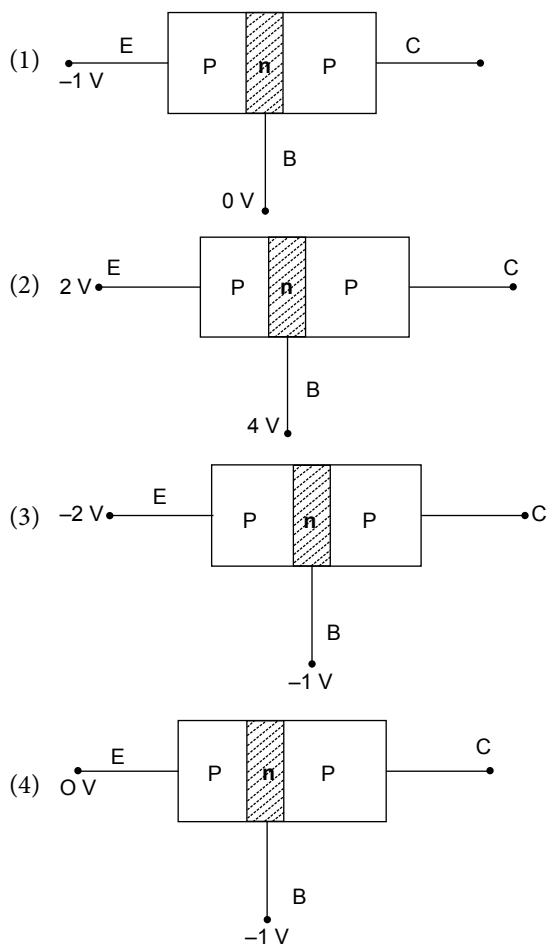
- (1) 20 mA (2) 200 mA
(3) 0.2 A (4) 40 A

29. In the following circuit, find the diode current when the diode potential is 0.5 V. Also find the forward resistance of the diode.



- (1) 0.5 A, 1Ω (2) 1 A, 0.5Ω
(3) 2 A, 1Ω (4) 5 A, 6Ω

30. Harinath took a pnp transistor and applied different voltages to emitter "E" and base "B" as shown in the figures (a, b, c and d). Find in which of the following the emitter is forward biased.



- (1) a, b (2) a, b, c
(3) a, b, c, d (4) a, c, d

ANSWER KEYS

PRACTICE EXERCISE 10 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 3 | 3. 3 | 4. 2 | 5. 3 | 6. 1 | 7. 3 | 8. 2 | 9. 4 | 10. 1 |
| 11. 4 | 12. 4 | 13. 2 | 14. 2 | 15. 2 | 16. 2 | 17. 4 | 18. 3 | 19. 4 | 20. 1 |
| 21. 3 | 22. 2 | 23. 1 | 24. 2 | 25. 1 | 26. 1 | 27. 2 | 28. 1 | 29. 2 | 30. 4 |

PRACTICE EXERCISE 10 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 2 | 4. 1 | 5. 2 | 6. 2 | 7. 2 | 8. 2 | 9. 3 | 10. 3 |
| 11. 2 | 12. 4 | 13. 2 | 14. 1 | 15. 3 | 16. 2 | 17. 3 | 18. 3 | 19. 4 | 20. 1 |
| 21. 3 | 22. 2 | 23. 3 | 24. 1 | 25. 2 | 26. 2 | 27. 2 | 28. 1 | 29. 1 | 30. 2 |

Sources of Energy and Our Universe

SYNOPSIS

- The capacity to do work is called energy. According to law of conservation of energy, energy can neither be created nor destroyed but can only be transformed from one form to another.
- A source from which energy is derived in the form of heat is called fuel. Any fuel from which energy can be derived is termed as source of energy.
- 'Energy sources which when used up cannot be replenished in a short period of time are called non-renewable sources of energy'.
- The energy sources that can be replenished in a short period of time once they are used up, are called renewable sources of energy.
- The difference between the output energy and input energy is termed as net energy output.
- A good source of energy should:
 - (i) have high ratio of output to input energy.
 - (ii) be easily available.
 - (iii) be risk free.
 - (iv) be convenient for storage and transportation.
 - (v) be economical to use.
- The sun is the ultimate source of energy, the heat that we feel in the sunlight is due to infrared radiation present in it.
- Black bodies are good absorbers as well as good radiators of heat energy.
- Petroleum deposits are formed from the dead remains of plants and animals buried under the sediments of the earth's crust millions of years ago and thus are referred to as fossil fuels.
- The major derivatives of petroleum (kerosene, diesel, petrol, lubricating oil etc.) are separated from the crude oil by the process of fractional distillation.
- Solar furnace, solar water heater, solar drier, solar cooker are some of the devices which make use of solar energy. These devices use a parabolic or a concave reflector to focus the solar energy at a point.
- Photoelectric effect: The phenomenon of ejection of electrons from a metallic surface when light of suitable frequency is incident on the metal surface is known as photoelectric effect. Solar cell is a photo electric cell, which converts light energy into electrical energy.
- The principle of a windmill is that the blades of a windmill are designed to create a pressure difference between its different regions when wind strikes them. This pressure difference produces a turning effect to make the blades rotate. The rotatory motion of the windmills is utilized to rotate the armature of an electric generator.
- Geothermal energy is the energy stored as heat inside the earth. The steam produced from geothermal source can be directly utilized to turn turbines of the

electric generator to produce electricity called geothermal electricity.

- Biogas is a mixture of methane, carbon dioxide, hydrogen and a small amount of hydrogen sulphide. Methane is the main constituent of biogas.
- In biogas plant, biogas is released by the process of anaerobic degradation.
- Nuclear fission is a process in which a heavy nucleus splits into lighter nuclei along with the release of huge amounts of energy.
- Animal dung decomposes due to the action of micro-organisms in the presence of water and produce mixture of gases like methane, CO_2 , H_2 and H_2S known as biogas. Combustion of biogas produces a large amount of heat without smoke, because its calorific value is high.
- Any substance that gives out energy on burning is called as a fuel.
- Calorific value is the energy liberated in the form of heat by a fuel, when its unit mass is burnt completely under ideal conditions. The SI unit of calorific value is J kg^{-1} . Hydrogen has the highest calorific value.
- The crude oil extracted from deep earth is separated into its constituents by a process called 'fractional distillation'.
- The system of stars, planets, the Sun and galaxies is termed as the universe. The universe consists of a large number of galaxies.
- The sun is at the centre of the solar system which holds eight planets, satellites, asteroids, meteors and comets under gravity.
- The planets with their structure similar to that of the earth are called terrestrial planets.
- The planets with their structure similar to that of Jupiter are called jovian planets.
- Small rocks revolving around the sun between the orbit of Mars and the Jupiter are called asteroids.
- The day on which the whole disc of the moon is visible is known as the full moon day and the day on which the moon is not visible is known as the new moon day.
- The time period between one full moon to the next full moon is $29\frac{1}{2}$ days on an average. This period is called Synodic month.
- The moon has no atmosphere and no water.
- One 'light year' is defined as the distance travelled by light in vacuum or in air in one year. The speed of light is nearly $3 \times 10^8 \text{ ms}^{-1}$, where one year is approximately 365 days and one day is equal to 86400 s. So 1 light year = $3 \times 10^8 \times 365 \times 86400 \text{ m} = 9.46 \times 10^{15} \text{ m}$.

- The position of one star in the night sky appears to be fixed with respect to the earth. It is called 'Pole Star'. As its position is along the axis of rotation of the earth, it appears to be fixed.
- The stars forming a group that has a recognisable shape is called a Constellation.
- There are eight planets revolving around the sun. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- A planet has a definite path in which it revolves around the Sun. This path is called an Orbit.
- The time taken by a planet to complete one revolution is called its period of revolution. The period of revolution increases as the distance of the planet from the sun increases.
- Any celestial body revolving around another celestial body is called its satellite.
- The planet Mercury is nearest to the sun.
- Venus is earth's nearest planetary neighbour and it is the brightest planet in the night sky. It is also called the morning or an evening star.
- Jupiter is the largest planet of our solar system.
- Saturn is the least dense among all the planets. Its density is less than that of water.
- The large gap between the orbits of Mars and Jupiter is occupied by a large number of small objects that also revolve around the sun, they are called Asteroids.
- Some small-sized celestial bodies from outside the solar system are pulled by the sun's gravitational field and come close to the sun in a parabolic path is called comet.
- Satellites are smaller bodies revolving around a planet.
- Meteors are small objects that occasionally enter the earth's atmosphere. When they fall freely the friction due to the atmosphere, heats it up. Some meteors are large and so they can reach the earth surface before they evaporate or burnout completely, they are called meteorites.
- According to Hubbles law, the velocity with which a galaxy is moving from the earth is directly proportional to the distance of the galaxy from the earth.
- The theories which explain the origin of the universe are big bang theory, pulsating theory and steady state theory.
- A group of stars, gas and dust particles held together by gravitational force is called galaxy.
- The stars are formed when huge gaseous clouds contract due to gravity, which is called nebula.

- The maximum mass of the white dwarf that can have is called Chandrasekhar limit.
- If the mass of the star is more than the Chandrasekhar limit and less than 3 times the solar mass it is called neutron star.
- If the mass of a neutron star becomes more than 3 times the solar mass it becomes a black hole.
- The different regions around the sun are photosphere, chromosphere and corona.

Solved Examples

1. If it takes 8 minutes and 20 seconds for sunlight to reach the earth, find the distance between the Earth and the Sun. The velocity of light is $3 \times 10^8 \text{ ms}^{-1}$.

☞ **Solution:** Using the formula,

Distance = speed \times time.

Substituting speed of light = $3 \times 10^8 \text{ ms}^{-1}$, $t = 8 \times 60 + 20 = 500 \text{ s}$, we get

Distance = $3 \times 10^8 \times 500 = 15 \times 10^{10} \text{ m}$.

2. Heat produced by burning 2 kg of a fuel, whose calorific value is 22000 kJ kg^{-1} , is utilized to boil certain mass of water which is at 34°C . Find the mass of water taken. (Specific heat capacity of water is $4200 \text{ J kg}^{-1} \text{ K}^{-1}$).

☞ **Solution:** Mass of fuel (m) = 2 kg

Calorific value of the fuel (S) = 22000 kJ kg^{-1}

$$= 22 \times 10^3 \times 10^3 \text{ J kg}^{-1} = 22 \times 10^6 \text{ J kg}^{-1}$$

Initial temperature of water (t_1) = 34°C

Final temperature of water (t_2) = 100°C .

$$\therefore \text{Rise in temperature} = (t_2 - t_1)$$

$$= (100 - 34)^\circ\text{C} = 66^\circ\text{C}$$

Specific heat capacity of water (S) = $4200 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$

Mass of water (m) = ?

Amount of heat energy produced on burning the fuel (Q) = mass of fuel \times calorific value.

$$= 2 \text{ kg} \times 22 \times 10^6 \text{ J kg}^{-1} = 44 \times 10^6 \text{ J}$$

Here, Heat lost by fuel = Heat absorbed by water.

$$44 \times 10^6 \text{ J} = m_w \times s_w \times \Delta t$$

$$\therefore 44 \times 10^6 \text{ J} = m_w \times 4200 \times 66$$

$$m_w = \frac{44 \times 10^6}{66 \times 42 \times 10^2} = \frac{1}{63} \times 10^4 \text{ kg} = \frac{100}{63} \times 10^2$$

kg.

$$= 1.59 \times 10^2 \text{ kg}.$$

Hence mass of water = 159 kg

3. How much energy will 1 kg mass of wood yield on complete combustion, if its calorific value were 18 kJ g^{-1} ?

☞ **Solution:** The calorific value of wood is given as 18 kJ g^{-1} . This means, 18 kJ of energy is released by burning 1 g of wood. Therefore, by burning 1 kg (1000 g) of wood, the energy released would be

$$Q = \text{mass of fuel} \times \text{calorific value} \\ = 1000 \times 18 \text{ kJ} = 18 \text{ MJ}.$$

4. The efficiency of a solar cell is 20% and its surface area is 4 cm^2 . Find the electrical energy generated in one second, by 3000 cells, connected in a solar panel, if 640 J of solar energy is incident on one meter square area, in one second.

☞ **Solution:** The total surface area of solar cells on which solar energy is falling = area of each cell \times no. of cells

$$= 4 \times 3000 \text{ cm}^2 = 1.2 \text{ m}^2.$$

The solar energy falling on 3000 cells

$$Q_1 = 1.2 \times 640 \text{ J} = 768 \text{ J}.$$

The energy converted into electric energy

$$= \frac{20}{100} \times 768 = 153.6 \text{ J}.$$

The electric energy generated in one second is 153.6 J .

5. A surface of area 1 m^2 kept perpendicular to the sun rays, absorbs 1.4 kJ of solar energy in every second.

(a) What is the amount of solar energy absorbed per second by a solar heater when its surface of area 10 m^2 is exposed perpendicular to the sun's rays?

(b) If the efficiency of the above solar heater is 50%, then what is the amount of time taken to heat 10 kg of water from 20°C to 50°C ? (Take specific heat of water as $4.2 \text{ kJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$)

☞ **Solution:** (a) The amount of solar energy absorbed by a surface kept perpendicular to sun's rays in one second is $= 1.4 \text{ kJ m}^{-2}$.

For 10 metre square area, solar energy absorbed $= 1.4 \times 10 = 14 \text{ kJ per second}$.

(b) The efficiency of the solar heater is $= 50\%$.

The amount of thermal energy required for 10 kg of water to raise its temperature from 20°C to 50°C is $Q = ms\Delta t$

$$\Rightarrow Q = 10 \text{ kg} \times 4.2 \text{ kJ kg}^{-1} \text{ }^\circ\text{C}^{-1} \times 30^\circ\text{C} \\ = 1260 \text{ kJ}$$

Energy received by solar heater in time 't' is $= 1.4 \times 10^3 \times 10 \times t$

$$\text{But } 50\% \text{ of } 1.4 \times 10^3 \times 10 \times t = 1260 \times 10^3$$

$$\therefore t = 180 \text{ s} = 3 \text{ minutes}$$

6. The heat produced on complete combustion of 20 g of a fuel could raise the temperature of 1.5 kg of water from 25°C to 75°C . Calculate the calorific value of the fuel, if the specific heat capacity of water is $4.2 \text{ J g}^{-1}\text{ }^\circ\text{C}^{-1}$. Assume that the heat absorbed by the container is negligible.

☞ **Solution:** The energy absorbed by water is $Q = m \times s \times \Delta t$.

$$\text{Substituting } m = 1.5 \text{ kg} = 1.5 \times 1000 \text{ g,}$$

$$S = 4.2 \text{ J g}^{-1}\text{ }^\circ\text{C}^{-1}$$

$$\text{and } \Delta\theta = 75 - 25 = 50^\circ\text{C.}$$

$$Q = 1.5 \times 1000 \times 4.2 \times 50 = 1.5 \times 1000 \times 210 \\ = 315 \text{ kJ.}$$

$$\text{Calorific value of the fuel} = \frac{315 \text{ kJ}}{20 \text{ g}} = 15.75 \text{ kJ g}^{-1}$$

7. A surface of area 1 m^2 kept perpendicular to the sun rays absorbs 1.8 MJ of solar energy in one hour.

(a) What is the amount of electrical energy produced when a solar panel of area 5 m^2 is exposed perpendicular to the sun rays for 5 h. Take the efficiency of solar panel as 30% .

(b) Calculate the power generated in kW.

☞ **Solution:** The amount of energy absorbed by 1 m^2 area $= 1.8 \text{ MJ h}^{-1} = 1.8 \times 10^6 \text{ J h}^{-1}$

The area of solar panel $= 5 \text{ m}^2$.

$$\therefore \text{The total amount of energy absorbed by solar panel in 1 hour} = 5 \times 1.8 \times 10^6 \text{ J h}^{-1} \\ = 9 \times 10^6 \text{ J h}^{-1}$$

$$\therefore \text{The amount of energy absorbed in } 5 \text{ h} = 5 \times 9 \times 10^6 \text{ J} = 45 \times 10^6 \text{ J}$$

$$\therefore \text{Efficiency of conversion} = 30\%.$$

$$\therefore \text{Amount of electric energy produced} \\ = 30\% [45 \times 10^6] \text{ J}$$

$$= \frac{30}{100} \times [45 \times 10^6] \text{ J} = 1.5 \times 9 \times 10^6 \text{ J}$$

$$= 13.5 \times 10^6 \text{ J} = 13.5 \text{ MJ.}$$

$$\therefore \text{Power generated (p)} =$$

$$\frac{E}{t} = \frac{\text{energy}}{\text{unit time}} = \frac{13.5 \times 10^6 \text{ J}}{5 \text{ hour}}$$

$$= \frac{13.5 \times 10^6 \text{ J}}{5 \times 60 \times 60 \text{ s}} = \frac{13.5}{36 \times 5} \times 10^4 \text{ J s}^{-1}$$

$$= \frac{13.5}{180} \times 10^4 \text{ W} = \frac{13.5}{18} \times 10^3 \text{ W} = 0.75 \text{ kW}$$

$$\therefore \text{Power generated} = 0.75 \text{ kW.}$$

8. How much time would it take for 1 litre of water to boil, initially at 0°C , if a concentrator type solar heater of area 5 m^2 is used, which can reflect 90% of energy incident on it? (Take solar constant as 1.4 kW m^{-2}).

☞ **Solution:** The solar energy falling on 5 m^2 area of solar heater per second is $= 1.4 \times 5 \text{ kJ} = 7 \times 1000 \text{ J}$
 90% of the above energy is used for heating water. So, the energy absorbed per second by water is

$$= \frac{90}{100} \times 7 \times 1000 = 6300 \text{ J} \quad \dots (1)$$

The energy required to boil 1 litre of water

$$= m \times s \times \Delta\theta = 1 \times 4.2 \times 10^3 \times 100 = 4.2 \times 10^5 \text{ J} \quad \dots (2)$$

The time required to boil the water is obtained by dividing (2) by (1).

$$\therefore t = \frac{4.2 \times 10^5}{6300 \times 60} \text{ min.} = 1.11 \text{ min.}$$

9. The height of water in a dam reduces by 20 m , which is used to generate electricity. The water further fell by 10 m into the tunnel to strike the turbine plates. If the volume of water is 10^4 m^3 , find the hydel energy generated. Assume all the potential energy of the water being converted into electricity. Take $g = 10 \text{ ms}^{-2}$.

☞ **Solution:** The potential energy of the stored water is converted into kinetic energy which is then converted into electrical energy.

The potential energy of water = mgh (1)

The volume of water = 10000 m^3 .

The mass of water = volume \times density = $10000 \times 1000 = 10^7 \text{ kg}$.

Also, the depth of water = 20 m .

\therefore The height of CG of stored water = 10 m .

The total height through which water falls = 20 m .

Substituting it in (1), we get potential energy of water = $10^7 \times 20 \times 10 = 2000 \text{ MJ}$.

10. Calculate the energy emitted by the sun in one second. Also estimate the mass of the sun that is converted to energy in one second.

(Take solar constant as $1.4 \times 10^3 \text{ W m}^{-2}$, distance between the earth and the sun as $1.5 \times 10^{11} \text{ m}$ and the velocity of light as $3 \times 10^8 \text{ ms}^{-1}$).

☺ **Solution:** One square metre of the earth gets 1.4 kW of energy in one second. The energy of the sun is spread over a spherical surface of area of $4\pi R^2$, where R is the distance between the earth and the sun.

Thus, the solar energy given out by the sun, in one second,

$$= 1.4 \times 10^3 \times 4\pi R^2 \text{ J}$$

$$= 1.4 \times 10^3 \times 4 \times \frac{22}{7} \times 1.5^2 \times 10^{22} \text{ J} = 3.96 \times 10^{26} \text{ J}$$

To produce this energy, the mass of the sun used per second is

$$m = \frac{c^2 \times t}{E} = \frac{3.96 \times 10^{26}}{9 \times 10^{16}} = 4.4 \times 10^9 \text{ kg.}$$

$$\therefore E = mc^2$$

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The laws governing the movement of celestial bodies are studied under the branch of physics called _____.
 (1) spintronics (2) astrophysics
 (3) nuclear physics (4) nano physics
2. The planets revolve round the sun in _____ orbits.
 (1) circular (2) spiral
 (3) elliptical (4) helical
3. In the year 1994, comet shoemaker Levy 9 collided with the planet _____.
 (1) mercury (2) mars
 (3) saturn (4) jupiter
4. If the temperature of a star is in the order of million degrees celsius it appears in _____ colour.
 (1) white (2) red
 (3) yellow (4) blue
5. The amount of energy emitted per unit time is called _____.
 (1) solar luminosity (2) luminous intensity
 (3) luminous flux (4) solar intensity
6. The unit of Hubble's constant is _____.
 (1) km s^{-1} (2) $\text{km s}^{-1} \text{pc}^{-1}$
 (3) km pc^{-1} (4) km s
7. If the temperature of a star is very high, it appears in _____ colour.
 (1) blue (2) red
 (3) yellow (4) orange
8. The periodical occurrence of comet Halley is _____ years.
 (1) 76 (2) 84
 (3) 102 (4) 96
9. The study of events connected to the earth and its structure is called _____.
 (1) terrestrial physics (2) geophysics
 (3) astro physics (4) nuclear physics
10. Temperature of jovian planets _____ than the temperature of terrestrial planets.
 (1) less than (2) greater than
 (3) equal to (4) less than or equal to
11. The period of rotation of the geostationary satellite is _____ hours.
 (1) 12 (2) 24
 (3) 6 (4) 48
12. Light year is a unit of _____.
 (1) time
 (2) average intensity of sun light in one year
 (3) distance
 (4) period of revolution of earth around sun
13. An artificial satellite is used for
 (1) communication.
 (2) weather monitoring.
 (3) remote sensing.
 (4) All the above.
14. In which of the following stages of a star gravitational force is maximum?
 (1) Red giant star (2) Protostar
 (3) Neutron star (4) Black hole
15. The fourth planet from the Sun is _____.
 (1) Mercury (2) Venus
 (3) Earth (4) Mars
16. Scorpio is an example of _____.
 (1) Comet (2) Constellation
 (3) Asteroid (4) Meteorite
17. _____ explains the origin of the universe.
 (1) Steady state theory
 (2) Pulsating theory
 (3) Big-Bang theory
 (4) All the above
18. The prominent star, Polaris is in the constellation of _____.
 (1) Pleides (2) Cannis Major
 (3) Ursa Major (4) Sagittarius
19. The periodic comet Halley is expected to be seen again in the year _____.
 (1) 2012 (2) 2052
 (3) 2062 (4) 2082

20. Aryabhata, Bhaskara, Apple, Rohini, etc., are names of _____.

- (1) astronomers
- (2) geophysicists
- (3) asteroids
- (4) satellites launched by India

21. A device which converts solar energy into electrical energy is _____.

- (1) voltaic cell
- (2) lechlanche cell
- (3) dry cell
- (4) photo voltaic cell

22. The meteors seldom reach the earth because of

- (1) freezing caused when they pass through the atmosphere.
- (2) vapourization caused when they pass through the atmosphere.
- (3) greater force of attraction towards sun.
- (4) greater force of attraction towards moon.

23. Which of the following metals is used as connecting wires that connect solar cells in a solar panel?

- | | |
|---------------|------------|
| (1) Copper | (2) Iron |
| (3) Aluminium | (4) Silver |

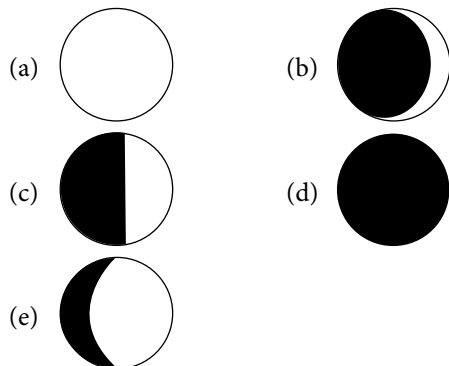
24. The most massive planet in the solar system is _____.

- | | |
|------------|-------------|
| (1) Saturn | (2) Earth |
| (3) Venus | (4) Jupiter |

25. In the sun hydrogen is converted to

- | | |
|------------|--------------|
| (1) helium | (2) oxygen |
| (3) carbon | (4) nitrogen |

26. The following are shapes of the moon viewed from the earth on different days. Arrange them in sequential order from a new moon day to full moon day. (In the following diagrams the unshaded part is the part visible from the earth).



- | | |
|---------------|---------------|
| (1) a b c e d | (2) d b c e a |
| (3) a e c b d | (4) a c b e d |

27. The essential (s) for combustion is (are)

- (1) a combustible material.
- (2) the presence of oxygen.
- (3) ignition temperature of the substance.
- (4) All the above

28. Which of the following has the highest calorific value?

- (1) LPG
- (2) CNG
- (3) Hydrogen
- (4) Petrol

29. The heat in solar radiation is mainly due to _____.

- (1) infrared radiations
- (2) ultraviolet radiations
- (3) visible light
- (4) X-rays

30. A device which converts solar energy into electrical energy is a _____.

- (1) photo current cell
- (2) quantum conducting cell
- (3) quantum voltaic cell
- (4) photo voltaic cell

31. The temperature in a spherical reflector type solar cooker is raised to above 500 °C

- (1) by concentrating energy at one point by using a concave reflector.
- (2) by proper insulation of the cooker.
- (3) by concentrating energy at one point by using a convex reflector.
- (4) Both (1) and (2)

32. The type of energy utilised by humans and animals to carry out their daily life activities is _____.

- (1) wind energy
- (2) geothermal energy
- (3) biochemical energy
- (4) hydro energy

33. The minimum height between the turbine and free surface of water in a reservoir to produce electrical energy is ____m.

- | | |
|--------|--------|
| (1) 28 | (2) 34 |
| (3) 20 | (4) 45 |

34. In a nuclear reactor, nuclear energy is obtained by breaking the nucleus of uranium by
- (1) fast moving neutrons.
 - (2) fast moving electrons.
 - (3) slow moving electrons.
 - (4) slow moving neutrons.
35. Red blood corpuscles lose the capacity to carry oxygen if
- (1) carbon monoxide gas is inhaled.
 - (2) sulphur dioxide gas is inhaled.
 - (3) nitrogen dioxide gas is inhaled.
 - (4) carbon dioxide gas is inhaled.

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The phases of moon between new moon and full moon are referred to as
 - (1) waxing of the moon.
 - (2) waning of the moon.
 - (3) crest of the moon.
 - (4) synodic month of the moon.
2. The output of a given windmill
 - (1) increases with an increase in wind velocity.
 - (2) decreases with an increase in wind velocity.
 - (3) is independent of wind velocity.
 - (4) Cannot be determined.
3. Which among the following is known as red planet?
 - (1) Mars
 - (2) Earth
 - (3) Mercury
 - (4) Venus
4. After sun, the star closest to the earth is _____.
 - (1) Alpha Centauri
 - (2) Sirius
 - (3) Pole star
 - (4) None of these
5. Which of the following is a false statement?
 - (1) To overcome the energy crisis the use of solar cooker must be increased.
 - (2) To overcome the energy crisis more amount of non-renewable sources of energy must be used.
 - (3) The re-usage of waste material as a source of energy can be done to overcome the energy crisis.
 - (4) To overcome the energy crisis water has to be saved.
6. Arrange the following planets in the increasing order of their distance from the sun.

(a) The earth	(b) Mars
(c) Venus	(d) Saturn
(1) c a b d	(2) a b c d
(3) d c b a	(4) b a c d
7. The fuels that cannot be replenished, once they are used are called _____.
 - (1) renewable sources
 - (2) non-renewable sources
 - (3) ultimate sources
 - (4) accessible sources
8. The process of burning a fuel is called _____.
 - (1) burnol
 - (2) combustion
 - (3) exhaustion
 - (4) fusion
9. Anthracite consists of _____.
 - (1) 94-98% of carbon
 - (2) 78-87% of carbon
 - (3) 91-94% of carbon
 - (4) 87-98% of carbon
10. In photoelectric effect, _____ present in solar energy changes into electric energy.
 - (1) only radiant heat
 - (2) visible light
 - (3) both radiant heat and light
 - (4) neither radiant heat nor light.
11. The temperature in a spherical reflector type solar cooker is raised to above 500 °C
 - (1) by concentrating energy at one point by using a concave reflector.
 - (2) by proper insulation of the cooker.
 - (3) by concentrating energy at one point by using a convex reflector.
 - (4) Both (1) and (2)
12. The brightest star in the night sky is _____.
 - (1) Sun
 - (2) Alpha centime
 - (3) Sirius
 - (4) Pleides
13. Which element contained in a fuel contributes to its high calorific value?
 - (1) Carbon
 - (2) Hydrogen
 - (3) Oxygen
 - (4) Nitrogen

14. Which among the following has the highest calorific value?
- (1) Hydrogen (2) Wood
(3) Coal (4) Butane
15. _____ are used to produce energy in OTEC.
- (1) Tidal energy
(2) Temperature difference between the different layers of water in ocean
(3) Ocean waves
(4) None of the above
16. Nuclear fusion reactions cannot be harnessed for productive applications because _____.
(A) these reactions require very high temperature and are controllable.
(B) these reactions require very high temperature and are uncontrollable.
(1) Only A is true.
(2) Only B is true.
(3) Both A and B are false.
(4) None of the above.
17. A good fuel should _____.
(1) be safe to store and transport
(2) be able to provide desired quantity of energy at a steady rate over a long period of time
(3) have low content of non-combustibles and no combustion products that are poisonous or environmental pollutants
(4) All the above.
18. Which among the following has the highest calorific value?
- (1) Petrol (2) Kerosene
(3) Ethanol (4) Wood
19. The fuel used as aviation fuel in jet aeroplanes is a special grade of _____.
(1) diesel (2) kerosene
(3) petrol (4) fuel oil
20. Choose the correct statement.
(1) The heat capacity of a substance is always equal to its specific heat capacity.
(2) The specific heat capacity of a substance changes as its mass and temperature changes.
(3) Calorific value of a fuel is independent of its mass.
(4) Liquid fuels have high calorific values.
21. The irregular patches observed in the image of the Sun are called _____.
(1) sunspots (2) sunpots
(3) sun image (4) sun dots
22. The distance between Andromeda and the Earth is _____ light years.
(1) 2×10^6 (2) 3×10^8
(3) 22×10^{16} (4) 12×10^8
23. There are total of _____ countries which have developed the technology for launching artificial satellites.
(1) five (2) six
(3) seven (4) four
24. The mass of the sun is nearly _____ % of the mass of the solar system.
(1) 99 (2) 99.9
(3) 89.9 (4) 88.8
25. Alpha centauri is at a distance of _____ km from the earth.
(1) 4.1×10^{13} (2) 11.9×10^{15}
(3) 2.5×10^{16} (4) 3.5×10^{18}
26. Quality that is not suitable for a fuel is _____.
(1) high calorific value with ignition temperature that is well above the normal room temperature
(2) low rate of evaporation at room temperature
(3) carbon particles are expelled with smoke
(4) low content of non-combustibles
27. If the output energy is 1000 J and input energy is 200 J the net output is _____ J.
(1) 800 (2) 1200
(3) 10 (4) 500
28. Which of the following planet has less density?
(1) Uranus (2) Mars
(3) Mercury (4) Venus
29. The present state of the Sun is _____.
(1) Red giant star
(2) Steady state
(3) White dwarf
(4) Supernova
30. Temperature of photosphere is about _____ K.
(1) 6000 (2) 10^6
(3) 10^8 (4) 0

31. If V is the velocity of a receding galaxy and R is the distance of the galaxy from the earth. Then the relation between V and R is _____.
 (1) $V \propto \frac{1}{R}$ (2) $V \propto R^2$
 (3) $V \propto R$ (4) $V \propto \frac{1}{R^2}$
32. Time taken by the light to reach the surface of the earth from the sun is _____.
 (1) 8 minutes
 (2) 3 minutes
 (3) 8 s
 (4) 80 s
33. From Hubble's law, the age of the universe is about _____ billion years.
 (1) 5 (2) 14
 (3) 8 (4) 12
34. Temperature of Corana is in the order of _____ K.
 (1) 6000 (2) 10^6
 (3) 10^8 (4) 0
35. A transponder is a _____.
 (1) moon of Jupiter
 (2) satellite sent to probe moon
 (3) remote sensing satellite sent by India
 (4) device used in satellites to receive signals from transmitting stations

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 4 | 4. 2 | 5. 1 | 6. 2 | 7. 1 | 8. 1 | 9. 2 | 10. 1 |
| 11. 2 | 12. 3 | 13. 4 | 14. 4 | 15. 4 | 16. 2 | 17. 4 | 18. 3 | 19. 3 | 20. 4 |
| 21. 4 | 22. 2 | 23. 4 | 24. 4 | 25. 1 | 26. 2 | 27. 4 | 28. 3 | 29. 1 | 30. 4 |
| 31. 1 | 32. 3 | 33. 2 | 34. 4 | 35. 1 | | | | | |

PRACTICE EXERCISE 11 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 1 | 4. 1 | 5. 2 | 6. 1 | 7. 2 | 8. 2 | 9. 1 | 10. 2 |
| 11. 1 | 12. 3 | 13. 2 | 14. 1 | 15. 2 | 16. 2 | 17. 4 | 18. 1 | 19. 2 | 20. 3 |
| 21. 1 | 22. 1 | 23. 2 | 24. 2 | 25. 1 | 26. 3 | 27. 1 | 28. 1 | 29. 2 | 30. 1 |
| 31. 3 | 32. 1 | 33. 2 | 34. 2 | 35. 4 | | | | | |

CHEMISTRY

PART 4

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Nature of Matter, Basic Concepts of Chemistry, Water and Solutions

SYNOPSIS

- The matter around us can be classified into three different states—solids, liquids and gases. The comparison of the three states of matter is tabulated below.

Property	Solids	Liquids	Gases
Mass	Definite mass	Definite mass	Definite mass
Volume	Definite volume	Definite volume	No definite volume
Shape	Definite shape	No definite shape, take the shape of the container	No definite shape
Density	High density	Lesser density than solids	Least density
Compressibility	Incompressible	Slightly compressible	Highly compressible
Rigidity	Rigid (cannot flow)	Fluid (can flow)	Fluid (can flow)
Free surfaces	Any number of free surfaces	One free surface that is only the upper surface	No free surfaces
Thermal expansion	Very low	Greater than solids	Much greater than both solids and liquids
Diffusion	Do not diffuse	Some liquids can diffuse into another. Example: water and alcohol. Some liquids do not diffuse. Example: oil and water	Gases diffuse spontaneously and rapidly.

(Continued)

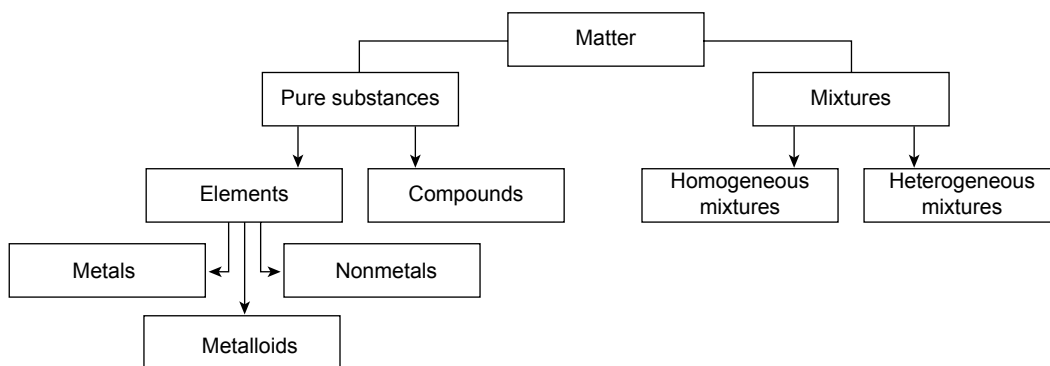
Property	Solids	Liquids	Gases
Molecular movement	Possess only vibratory motion, and the mean position is fixed.	Possess vibratory and rotatory motion in addition to translatory motion.	Possess vibratory, rotatory and translatory motion in all directions randomly.
Kinetic energy	Very low kinetic energy	Kinetic energy is more than that of solids	Possess the highest kinetic energy

- Molecules have forces of attraction between them known as intermolecular forces of attraction. The force of attraction between similar molecules is called **cohesive force** and that between dissimilar molecules is called **adhesive force**.
- **Interconversion of states of matter:** Since the physical behaviour of matter in various states depends upon the molecular arrangement which can be changed by changing the conditions of temperature and pressure, matter can be converted from one state to another state under suitable conditions. This is also termed as **phase transition**. During this process the mass remains same.
- The temperature at which a solid gets converted to liquid state at the atmospheric pressure is called **melting point** of the solid.
- **Factors affecting melting point:** Though every solid has a specific value of melting point under normal atmospheric conditions, certain factors affect the melting point of solids.
 - (i) **Effect of pressure:** The effect of pressure on the melting point of solids depends upon the nature of solid.
For solids which expand on melting, increase in pressure increases the melting point.
Examples: Paraffin wax, silver, gold, copper.
For solids which contract on melting, increase in pressure decreases the melting point.
Examples: Ice, cast iron, brass.
 - (ii) **Effect of addition of impurities:** Addition of impurities to a solid decreases the melting point of solid thereby allowing the substance to melt at a lower temperature.
Example: Rose metal—alloy of tin, lead and bismuth.
Melting point of this alloy is 94.5°C
Melting point of lead is 327°C
Melting point of tin is 231.9°C
Melting point of bismuth is 271°C
- The temperature at which a liquid converts into solid at the atmospheric pressure is called **freezing point** of the liquid. Freezing point of the liquid is equal to the melting point of the solid for the same substance.
- A mixture of 3 parts of ice and 1 part of common salt is called **freezing mixture** which is used to produce a low temperature of -21°C.
- The process of conversion of liquid state to gaseous state is called **boiling** and the temperature at which the conversion of liquid state to gaseous state takes place at normal atmospheric pressure is called **boiling point**. At the boiling point, the vapour pressure of a liquid becomes equal to atmospheric pressure (external pressure). Since the vapour pressure of different liquids are different, they have different boiling points.
- **Factors affecting boiling point**
 - (i) **Effect of pressure:** The boiling point of a liquid increases with increase in external pressure. This principle is made use of in the working of pressure cooker. At higher altitudes, water boils below 100°C because of lower pressure.
 - (ii) **Effect of impurities:** When any solid substance is dissolved in a liquid, the boiling point of liquid rises beyond the normal boiling point. For example, when common salt is dissolved in water, the solution boils at a temperature greater than 100°C.
- **Factors affecting evaporation**
 - (i) **Surface area:** Increase in surface area increases the rate of evaporation.
 - (ii) **Temperature:** Increase in temperature increases the rate of evaporation.
 - (iii) **Humidity:** The amount of water vapour which the atmospheric air holds is called **humidity**. Increase in humidity decreases the rate of evaporation.
 - (iv) **Wind speed:** Increase in wind speed increases the rate of evaporation.
- The constant temperature at which a gas changes into liquid is called **condensation point**.

- The conversion of gaseous state to liquid state can also be brought about by the application of pressure. The gases have to be cooled below a certain temperature and then subjected to application of high pressure. This entire process is called **liquefaction**.
- For every gas there is a limiting temperature above which a gas cannot be liquefied howsoever high pressure is applied is called **critical temperature**.
- The temperature at which the atmospheric air becomes saturated with water vapour at constant pressure is called **dew point**.
- The process of conversion of solid state into vapour state directly without passing through liquid state is called **sublimation**. The vapours when condensed give back the solid.
- The stored heat energy which remains hidden within the matter and helps it to undergo transformation

from one state to another at constant temperature is called **latent heat**.

- The amount of heat energy required to convert 1 g of a solid into liquid at atmospheric pressure and at its melting point is known as the **latent heat of fusion**. For ice, it is equal to 80 cal per gram.
- The amount of heat energy required to convert 1g of liquid into gas at atmospheric pressure and at its boiling point is known as **latent heat of vapourization**.
- **Cooling produced due to evaporation:** During evaporation the liquid molecules absorb energy from the surroundings and overcome the forces of attraction thereby going into vapour state. Since surroundings lose energy, it becomes cold.
- Classification of matter based on chemical composition:



- In case of a pure substance, the molecule may contain similar atoms or dissimilar atoms. The first category of pure substances in which a molecule is made up of atoms of the same kind are called **elements**.
- The second category of substances in which a molecule is made up of dissimilar atoms are called **compounds**. For example, a molecule of carbon dioxide is made up of one carbon atom and two oxygen atoms. Since compounds possess only one kind of molecules, they are invariably homogeneous.
- Mixtures are those substances which contain two or more kinds of molecules. For example, common salt solution contains molecules of sodium chloride and molecules of water. Mixtures may have constituents as elements, an element and a compound or only compounds.
- As mixtures contain more than one type of molecules, the distribution of these particles may be uniform or non uniform. Depending on the distribution of the

different kinds of molecules within the mixture, they are classified into two types. **Homogeneous mixtures** have uniform distribution of the different types of molecules in the mixture. **Heterogeneous mixtures** have non uniform distribution of the different types of molecules in the mixture.

- Based on their nature, elements are classified as metals, non-metals and metalloids. The elements are given symbols to be represented in short form.

Examples: Sodium (Na), magnesium (Mg), aluminium (Al), copper (Cu) etc., are metals.

Hydrogen (H), oxygen (O), helium (He), sulphur (S) etc., are non-metals.

Arsenic (As), antimony (Sb), selenium (Se), tellurium (Te), germanium (Ge) are metalloids.

- Elements can also be classified on the basis of their atomicity. The number of atoms present in the molecule of an element is called **atomicity**.

- **Monoatomic elements:** The molecule of the element is made up of only one atom. All metals, noble gases and some non-metals are monoatomic.
Examples: Silver (Ag), aluminium (Al), gold (Au) etc. are metals.
Helium (He), neon (Ne) etc., are noble gases.
Boron (B), carbon (C) etc., are non-metals.
- **Diatomic elements:** The molecule of the element is made up of two atoms.
Examples: Hydrogen (H_2), oxygen (O_2), nitrogen (N_2) etc.
- **Polyatomic elements:** The molecule of the element is made up of more than two atoms. Very few elements are polyatomic.
Examples: Ozone (O_3), phosphorus (P_4), sulphur (S_8)

○ Separation of solid-solid mixtures

Method	Property exploited	Description with example
Solvent extraction	Solubility of one component in a solvent.	A mixture of sulphur and sand. Sulphur is soluble in carbon disulphide (CS_2) and sand is insoluble.
Magnetic separation	Magnetic property of one component.	Mixture of iron ore and sand. Iron ore is attracted by magnet and sand is left behind.
Gravity method	Difference in densities of components.	Mixture of sand and chalk powder. Sand being heavier than chalk powder sinks in water whereas chalk powder floats on water.
Sublimation	Ability of one component to sublime.	Mixture of iodine and sand. On heating iodine sublimes leaving behind sand. The vapours on cooling give solid iodine.
Fractional crystallization	Difference in solubility of the components in the same solvent.	Mixture of potassium nitrate (KNO_3) and sodium chloride ($NaCl$). When hot saturated solution of KNO_3 and $NaCl$ is cooled slowly, KNO_3 crystallizes and settles down whereas $NaCl$ remains in the solution. This is because the solubility of KNO_3 decreases to a large extent on cooling. But the decrease in solubility of $NaCl$ with the decrease in temperature is insignificant.

○ Separation of solid-liquid mixtures

Method	Property exploited	Description with example
Sedimentation and decantation	High density of insoluble solid component	Mixture of sand and water. Sand being heavier settles at the bottom and liquid is slowly transferred into another container.
Filtration	Size of the particles of insoluble solid component	Mixture of barium sulphate ($BaSO_4$) and water (H_2O). On passing through filter paper, water passes through filter paper and barium sulphate ($BaSO_4$) remains on the filter paper.
Evaporation	The ability of solid to remain unrecompensed when solution is heated up to the boiling point of the liquid component	Mixture of sugar and water. Water evaporates on heating leaving behind crystals of sugar.
Distillation	Heating the solution to the boiling point of liquid component followed by condensation of the vapours	Mixture of sodium chloride ($NaCl$) and water. Water evaporates and condenses back to water and sodium chloride ($NaCl$) is left behind in the distillation flask.
Centrifugation	Density of solid particles in comparison to that of liquid particles	Milk contains solid fat particles in it. When this is subjected to centrifugation, lighter fat particles float and are skimmed off.

○ Separation of liquid-liquid mixtures

Method	Property exploited	Description with example
Separating funnel	Difference in densities of the two liquid components	Kerosene oil and water are immiscible liquids. When the mixture is taken in the separating funnel, the lighter liquid (kerosene) forms top layer and the heavier liquid (water) settles down.
Fractional distillation	Difference in boiling points of the liquids	Ethyl alcohol and water are miscible liquids. Ethyl alcohol has a lower boiling point than water and hence vaporises. Alcohol vapour gets condensed and collected in a receiver. Water is left behind in the distillation flask.

○ Separation of gas-gas mixtures

Method	Property exploited	Description with examples
Diffusion	Difference in densities of component gases	The gas with lower molecular weight diffuses faster than the gas with higher molecular weight. Examples: Hydrogen (H_2) and methane (CH_4) helium (He) and sulphur dioxide (SO_2)
Dissolution in suitable solvent	Difference in solubility of component gases in a given solvent	A mixture of carbon dioxide (CO_2) and carbon monoxide (CO). Carbon dioxide (CO_2) is soluble in potassium hydroxide (KOH) while carbon monoxide (CO) is not. In a mixture of ammonia (NH_3) and nitrogen (N_2), ammonia (NH_3) is soluble in water and nitrogen (N_2) is insoluble.
Preferential liquefaction	Difference in tendencies of component gases to be liquefied under pressure	A mixture of ammonia (NH_3) and hydrogen (H_2). Ammonia gets liquefied under high pressure and hydrogen gas is left behind.
Fractional evaporation	Difference in boiling points of the component gases	When air is liquefied, the major components of air, nitrogen (N_2) and oxygen (O_2) can be separated by subjecting the liquid to evaporation. Nitrogen (N_2) has a lower boiling point and hence boils off, oxygen (O_2) has a higher boiling point and left behind.

- **Paper chromatography:** Apart from all different methods of separation of mixtures, there is a special technique for separation and identification of the constituents in the mixture.

- **Principle:** It is based on the difference in adsorption of constituents by a surface of an appropriate adsorbent material or solid medium (stationary phase). The rate of adsorption of a particular constituent depends upon its solubility in the solvent (moving phase) taken.
Examples: Separation of colours in a dye, pigments from natural colours and drugs from blood.

- **Symbols** are the shorthand notations representing a single atom of an element, and generally consist of a letter or combination of letters derived from the name of the element.

- The **formula** represents the number of atoms of each element present in the molecule.

- The combining capacity of an atom is known as its **valency**.

- **Valency of an element** can also be defined as the number of hydrogen atoms which combine with one atom of the element.

Example: $H_2O \Rightarrow$ Valency of O = 2

- **Valency with respect to chlorine:** Since valency of chlorine is one, the number of chlorine atoms with which one atom of an element can combine is called its **valency**.

Example: $NaCl \Rightarrow$ Valency of Na = 1

- **Valency with respect to oxygen:** In another way, **valency** can be defined as double the number of oxygen atoms with which one atom of an element can combine since valency of oxygen is two.

Example: $\text{MgO} \Rightarrow \text{Valency of Mg} = 2$

- **Ions or Radicals:** An atom or a group of atoms, when they either lose or gain electron (s), gets converted into ions.
- Ions formed by the loss of electron (s) are positively charged and are called **cations** or **positive ions**

Example: $\text{Na} \xrightarrow{-1e^-} \text{Na}^+$
cation

- The ions formed by the gain of electron (s) are negatively charged and are called **anions** or **negative ions**

Example: $\text{F} \xrightarrow{+1e^-} \text{F}^-$
anion

- Group of atoms bonded together with a specific charge and behave as an ion is called a **polyatomic ion** or **radical**. These radicals retain their identity in a chemical reaction.

Examples: NH_4^+ , CO_3^{2-} , SO_4^{2-} , ClO_4^- etc.

- Some metals may lose different number of electrons to form ions with different charges. This is called **variable valency**.
- In some cases, the electrons are also lost from the penultimate shell.

Example: Iron loses two electrons from its valence shell to form Fe^{+2} and loses one more electron from penultimate shell to form Fe^{+3} . Thus iron exhibits variable valency.

- **Naming of different types of acids**

Type of Acid	Type of negative radical	Suffix
(1) Binary acid	Negative radical consists of a single non-metal Examples: HCl, HBr	'ic' (prefix hydro) Hydrochloric acid, hydrobromic acid
(2) Oxy acid	Negative radical consists of a non-metal and oxygen. The name of the oxy acid depends on the percentage of the oxygen associated with a specific non-metal. Acids with comparatively less percentage of oxygen. Examples: H_2SO_3 , HNO_2 , H_3PO_3 Acids with comparatively more percentage of oxygen. Examples: H_2SO_4 , HNO_3 , H_3PO_4	'ous' sulphurous acid, nitrous acid, phosphorous acid 'ic' sulphuric acid, nitric acid phosphoric acid

- **Naming of bases:** Bases generally contain hydroxyl radical (OH^-) as the negative radical and a metal ion as its positive radical. While writing the name of the base, the name of the metal is written first followed by hydroxide.

Examples:

$\text{Ca}(\text{OH})_2$	Calcium hydroxide
$\text{Mg}(\text{OH})_2$	Magnesium hydroxide
NaOH	Sodium hydroxide
$\text{Al}(\text{OH})_3$	Aluminium hydroxide

- **Naming of salts:** The positive radical present in the salt comes from the corresponding base and the negative radical comes from the corresponding acid.

Name of the salt starts with the name of the metal present as positive radical which is followed by the

name of the negative radical. Name of the negative radical depends on the name of the acid from which the salt is produced.

Acid from which the salt is produced	Suffix and name of the salt
1. 'ous' acid Examples: Sulphurous acid (H_2SO_3) Nitrous acid (HNO_2)	'ite' $\text{CaSO}_3 \rightarrow$ Calcium sulphite $\text{Zn}(\text{NO}_2)_2 \rightarrow$ Zinc nitrite
2. 'ic' acid Examples: Sulphuric acid (H_2SO_4) Nitric acid (HNO_3) Phosphoric acid (H_3PO_4)	'ate' $\text{ZnSO}_4 \rightarrow$ Zinc sulphate $\text{NaNO}_3 \rightarrow$ Sodium nitrate $\text{AlPO}_4 \rightarrow$ Aluminium phosphate

- If NH_4^+ is present as positive radical in the base or in the salt, ammonium is written in place of the name of the metal.

Example:

Ammonium hydroxide (base) $\rightarrow \text{NH}_4\text{OH}$

Ammonium phosphate (salt) $\rightarrow (\text{NH}_4)_3\text{PO}_4$

- The mass of 1/12th part of carbon –12 isotope is taken as the standard. The mass of the atoms of other elements are calculated with respect to the number of times an atom of an element is heavier than 1/12th part of a carbon –12 isotope. This is called the **atomic mass** or the **relative atomic mass**. Since the mass of $\frac{1}{12}$ th part of a carbon –12 isotope is called **atomic mass unit**, the relative atomic mass is expressed in amu.
- Nowadays amu is named as ‘dalton’ or unified mass designated as u. Value of amu is 1.624×10^{-24} g. This is also equal to mass of one atom of hydrogen.
- **Gram atomic mass or gram atom:** The relative atomic mass expressed in grams is called gram atomic mass. The amount of substance equal to gram atomic mass is called **gram atom**.
- **Molecular mass or relative molecular mass:** Relative molecular mass also was first determined in hydrogen scale and later by taking carbon –12 isotope as standard. **Molecular mass** is a number which indicates how many times, a molecule of a substance is heavier in comparison to $\frac{1}{12}$ th part of a one carbon –12 isotope.
- **Gram molecular mass or gram molecule:** **Molecular mass** expressed in grams is called **gram molecular mass**. The amount of substances equal to gram molecular mass is called **gram molecule**.
- **Law of conservation of mass:** All chemical reactions occurring in nature should comply with law of conservation of mass. The law states that the total mass of reactants taking part in a chemical reaction is equal to the total mass of products obtained. This law holds good only for chemical reactions and not for nuclear reactions.
- **Balancing of chemical equation:** This is done by hit and trial method as the smallest whole number coefficient is used and its multiples are tried till the suitable number is obtained.

Step I: The number of atoms of different elements present in the reaction are counted. The number of atoms of reactants and products

is written on left hand side and right hand side respectively.

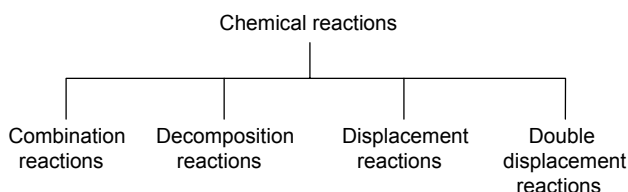
Step II: The balancing can be started with the compound containing maximum number of atoms or minimum number of atoms.

Step III: The various elements are balanced in the decreasing order of number of atoms in the first case and increasing order of number of atoms in the second case.

Step IV: Certain symbols will be incorporated in the balanced chemical equation in order to give additional information regarding the reaction. A two sided arrow (\rightleftharpoons) indicates that the reaction is reversible. The physical states of the substances can be represented as s, l and g in brackets for solid, liquid and gas respectively. The symbol (aq) represents aqueous solution.

Step V: The symbol Δ represents heating. Other conditions such as temperature, pressure, catalyst are written on the arrow like Δ . Upward arrow (\uparrow) indicates the gaseous product and downward arrow (\downarrow) indicates the substance in the form of precipitate.

- **Equivalent mass:** The equivalent mass of an element is defined as the number of parts by mass of that element which can displace or combine with 1.008 parts by mass of hydrogen or 8 parts by mass of oxygen or 35.5 parts by mass of chlorine. Like molecular mass, equivalent mass has no units. Equivalent mass expressed in grams is called **gram equivalent mass**.
- **Relation between equivalent mass and atomic mass:** The valency of an element can be defined as the number of hydrogen atoms with which one atom of an element can combine to form a compound.
- All the chemical reactions can be broadly classified into four types depending upon the nature of the reaction.

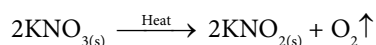


- **Combination reactions:** A chemical reaction in which two or more substances combine to form a single new substance is called a **combination reaction**.

- **Law of definite proportions:** The law of definite proportions states that a pure compound contains the various elements combined in definite proportions by weight irrespective of the method of preparation.
- **Law of multiple proportions:** When two elements combine in different ratios to give more than one type of compound, the masses of the element that combines with a fixed weight of the other element always bear a simple integral ratio.
- **Decomposition reactions:** The reaction in which a single compound splits into two or more simpler substances is known as **decomposition reaction**.

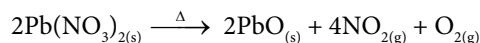
Representation: $AB \rightarrow A + B$

Example:



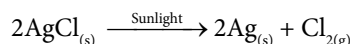
If the decomposition of the substance takes place by the absorption of heat, it is called **thermal decomposition**.

Example:



If the decomposition of a substance takes place in the presence of light, it is called **photolytic decomposition (photolysis)**.

Example:

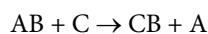


The above reaction is used in the black and white photography.

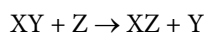
If the decomposition of the substance takes place by the passage of electricity, it is called **electrolytic decomposition (electrolysis)**.

- **Displacement reaction:** In a displacement reaction, the more reactive element displaces the less reactive element from its compound.

Representation:



Metal




Non-metal

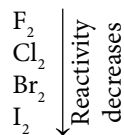


- The ability of an element to displace another element is known by its relative position in the **reactivity series**.

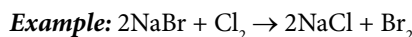
○ Metal reactivity series

Potassium	K	(Most reactive metal)
Sodium	Na	<div style="text-align: center;">  <p>Reactivity decreases</p> </div>
Calcium	Ca	
Magnesium	Mg	
Aluminium	Al	
Zinc	Zn	
Iron	Fe	
Nickel	Ni	
Tin	Sn	
Lead	Pb	
Hydrogen	H	
Copper	Cu	
Mercury	Hg	
Silver	Ag	
Gold	Au	
Platinum	Pt	(Least reactive metal)

○ Halogen reactivity series

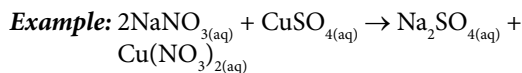


- The more reactive halogen displaces the less reactive halogen from its compound.

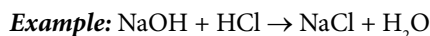


- **Double decompositions/Double displacement reactions:** The chemical reaction in which two reactants combine to form two new substances by mutual exchange of their radicals is called **double decomposition** or **double displacement reaction**.

Representation: $AB + CD \rightarrow AD + CB$



- If the reaction takes place between an acid and a base, it is called **neutralization reaction**. Salt and water are formed in this reaction.



- In a double decomposition reaction, if one of the products is insoluble, it is called precipitate and the reaction can be called **precipitation reaction**.



- The chemical reactions may be associated with release or absorption of energy. If the reaction involves release of energy, the reaction is said to be **exothermic reaction**. If the reaction involves absorption of energy, the reaction is said to be **endothermic reaction**.

- **Exothermic reactions:** A chemical reaction associated with evolution of heat energy is called **exothermic reaction**.

Representation: Reactants \rightarrow Products + Q kcal
(or)

Reactants – Q Kcal \rightarrow Products

Q = Heat energy released

Example: $C + O_2 \rightarrow CO_2 + 94 \text{ kcal}$

- **Respiration:** The process of breaking down of glucose molecules into simpler molecules is also accompanied by release of heat energy.



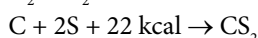
- **Endothermic reactions:** A chemical reaction which proceeds with the absorption of heat energy is called **endothermic reaction**.

Representation: Reactants + Q kcal \rightarrow Products
(or)

Reactants \rightarrow Products – Q kcal

Q = Heat energy absorbed

Example: $N_2 + O_2 \rightarrow 2NO - 44 \text{ kcal}$

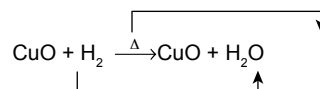


- **Oxidation and reduction reactions:** In addition to the above categories, chemical reactions are categorised as redox reactions, as they involve both oxidation and reduction reactions. Oxidation and reduction are an important class of reactions

Oxidation	Reduction
(1) Addition of oxygen or electronegative element to a substance. Example: $2Mg + O_2 \rightarrow 2MgO$	Removal of oxygen or electronegative element from a substance. Example: $2Hg_2O \xrightarrow{\Delta} 4Hg + O_2$
(2) Removal of hydrogen or electropositive element from a substance or electrons from an element. Example: $H_2S + Cl_2 \rightarrow 2HCl + S$	Addition of hydrogen or electropositive element to a substance or electrons to an element Example: $H_2 + Cl_2 \xrightarrow{\text{Light}} 2HCl$

- Oxidation and reduction are simultaneous processes since oxidation of a substance is accompanied by reduction of another substance. Hence, these reactions are said to be **redox reactions**.

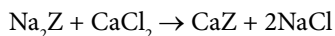
- In a redox reaction, the substance which undergoes oxidation is called **reducing agent** and the substance which undergoes reduction is called **oxidizing agent**.



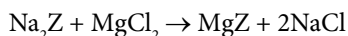
CuO is called oxidizing agent and hydrogen is called reducing agent.

- The change undergone by some metals on exposure to moisture, acids, etc., is called **corrosion**.
- **Water** in the liquid state is found in oceans and seas. Apart from this, liquid water is also found in rivers, lakes, streams and other water bodies. Water available in the above sources is called **surface water**. Water present in oceans and seas contains appreciable proportions of dissolved salts, predominantly sodium chloride. The presence of these salts imparts salty taste to water and hence this water is called **saline water**.
- In addition to surface water, water is also available under the earth's surface. This is called **underground water**. This water is stored due to the seepage of rain water through the soil. The underground water may come out in the form of springs. This can be drawn out artificially by digging wells or with the help of tube wells.
- Water that dissolves soap and readily produces lather is known as **soft water**. Rain water and distilled water are the examples of soft water.
- Water that produces a curdy substance on the addition of soap and cannot produce lather easily is known as **hard water**. This happens due to the presence of dissolved salts like chlorides, sulphates and bicarbonates of calcium and magnesium.
- Hardness of water can be classified into two types depending on the nature of dissolved salts present in it. These are **temporary hardness** and **permanent hardness**.
- Removal of hardness
- **Temporary hardness** By boiling:
 $Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$
 $Mg(HCO_3)_2 \rightarrow MgCO_3 + CO_2 + H_2O$
Precipitates of $CaCO_3$ and $MgCO_3$ can be filtered off.
- **Temporary and permanent hardness**
(a) **By passing through permutit:** Artificial zeolite called permutit is obtained in the form of coarse

sand when sodium carbonate, alumina and silica are fused together. Hard water containing dissolved salts of calcium and magnesium is made to percolate through permutit present in a suitable column by which the water is softened.

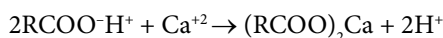


zeolite

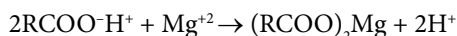


(b) By passing through ion exchange resins:

Removal of cation

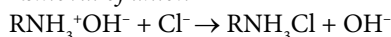


acid resin

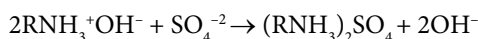


acid resin

Removal of anion



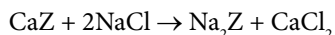
basic resin



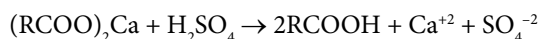
basic resin

[acid and basic resins are giant organic molecules where R represents the alkyl group]

- Water on passing through ion exchange resin, it becomes free from ions which is called **deionised or demineralized water**.
- After prolonged use, permutit or resins lose their activity and are hence required to be reactivated. The exhausted sodium zeolite is regenerated by treating with sodium chloride solution.



- Acid resin can be regenerated by using a strong acid like H_2SO_4 , whereas regeneration of basic resin is carried out by treating it with strong base like NaOH.

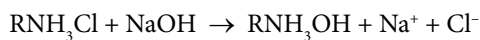


acid resin

after use

regenerated

acid resin



basic resin

after use

regenerated

basic resin

Physical properties of water

- (a) **Freezing point:** The freezing point of water is 0°C under normal atmospheric pressure. The freezing point of water decreases with an increase in external pressure. Presence of soluble impurities decreases the freezing point of water.
- (b) **Boiling point:** The boiling point of pure water is 100°C under normal atmospheric pressure. The boiling point of water gets elevated due to the presence of soluble impurities. Increase in

external pressure increases the boiling point of water.

- (c) **Density:** The maximum density of water is 1 gm/cc and is obtained at 4°C . The density of water increases with increase in temperature upto 4°C . Later, density of water decreases with increase in temperature beyond 4°C .
- (d) Water shows an unusual behaviour between 0°C and 4°C temperature. In this range of temperature, water expands on cooling instead of contracting. This phenomenon of unusual expansion of water between 0°C to 4°C is called **anomalous expansion**.
- (e) **Conductivity:** Pure water is a bad conductor of heat and electricity. The electrical conductivity of water is due to the presence of dissolved salts in water.
- (f) **Specific heat:** The amount of heat energy required to raise the temperature of unit mass of a substance through 1°C or 1K is called specific heat capacity of that substance. Specific heat capacity of pure water is $1 \text{ calorie gram}^{-1} \text{ }^\circ\text{C}^{-1} = 4 \times 2 \text{ joule gram}^{-1} \text{ }^\circ\text{C}^{-1}$. Water has the highest specific heat capacity among all the substances.
- (g) **Latent heat of fusion and latent heat of vapourisation:** The amount of heat required to be supplied to unit mass of ice for converting it to water without any change in the temperature is called latent heat of fusion of ice. Latent heat of fusion of ice = 80 calories/gram .
- (h) The amount of heat required to be supplied to unit mass of water for converting it to steam without any change in the temperature is called latent heat of vaporization of water. Latent heat of vaporization of water = $540 \text{ calories/gram}$.

Chemical properties of water

Action of water on certain metals

- (a) **Potassium and sodium:** These two metals react with cold water. They even react with moisture (water vapour). Potassium burns with lilac flame and sodium burns with golden yellow flame.

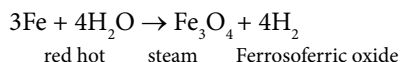
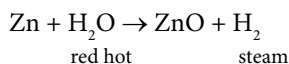
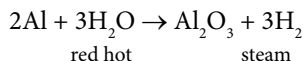
$$2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$$

$$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$$
- (b) **Calcium:** This reaction takes place in cold water.

$$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$$
- (c) **Magnesium:** Powdered magnesium on treatment with boiled water produce corresponding oxide and hydrogen gas.

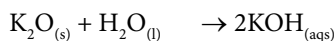
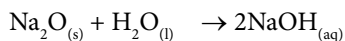
$$\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$$

(d) **Aluminium, zinc and iron:** Red hot aluminum, zinc and iron react with steam and liberates hydrogen gas.



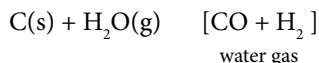
Action of water on metallic oxides

Only oxides of active metals such as sodium, potassium and calcium react with cold water to form their respective hydroxides. These reactions are exothermic in nature.



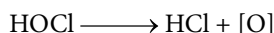
Action of water on certain non-metals

(a) **With carbon:** When superheated steam is passed over charcoal, it produces a mixture of equal volume of hydrogen and carbon monoxide gas which is collectively called **water gas**.



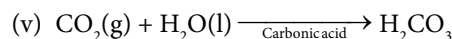
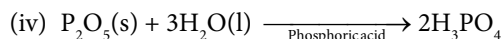
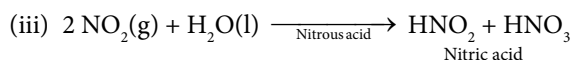
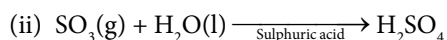
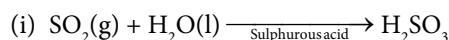
The above reaction is endothermic in nature.

(b) **With chlorine gas:** Chlorine gas dissolves in water in dark to produce greenish yellow solution called **chlorine water**. Chlorine water produces hydrochloric acid and nascent oxygen under diffused sunlight. The reaction becomes vigorous under direct sunlight.



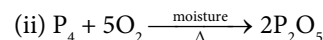
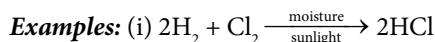
○ Action of water on non-metallic oxides

Non-metallic acidic oxides combine with water to form corresponding acids.



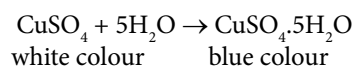
○ Catalytic property

Water or moisture act as catalyst for few reactions.

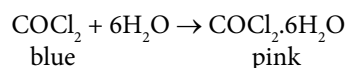


○ Tests for water

(i) When few drops of water are added to white anhydrous copper sulphate, it turns blue.



(ii) Water turns blue anhydrous cobalt chloride pink.



- A solution is a homogeneous mixture of two or more substances. The proportion of the constituents of the solution can be varied within certain limits. The solutions comprising of two components are called **binary solutions**.
- That component of a solution which is in the same physical state (i.e., solid, liquid or gas) as the solution is called **solvent**, the other component is called the **solute**.
- If both the components are in the same state, the component which is present in larger proportions is called **solvent** and the one which is present in minor proportions is called **solute**.
- Depending on the physical states of the solute and the solvent, solutions can be classified into various types.

Solvent	Solute	Example
Solid	solid	Alloys of metals
	liquid	Hydrated crystalline salts
	gas	Hydrogen gas adsorbed on platinum or palladium
Liquid	solid	Common salt in water
	liquid	Petrol in kerosene
	gas	Aerated water or soft drinks
Gas	gas	Air

- When the solvent is a gas and the solute is a solid or a liquid, the resultant mixture becomes heterogeneous.

All other solutions being homogeneous are called true solutions. The other two types of mixtures being heterogeneous are called suspensions. Example, fog, mist, dust particles in air.

- **Solubility:** The process of dissolving a substance in the given solvent is called **dissolution**. The amount of solute dissolved in a definite quantity of a solvent depends upon the nature of solute as well as nature of solvent.
- The maximum amount of a particular solute in grams, which can dissolve in 100 grams of solvent at a given temperature is called **solubility**.

$$\text{Solubility} = \frac{\text{Mass of solute}}{\text{Mass of solvent}} \times 100$$

Example: Solubility of copper sulphate in water at 20°C is 20g and solubility of potassium chloride in water at 20°C is 34.

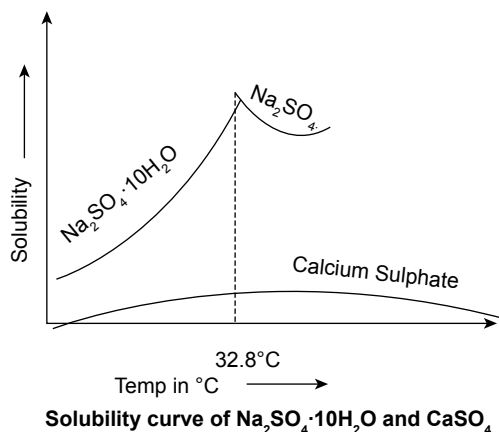
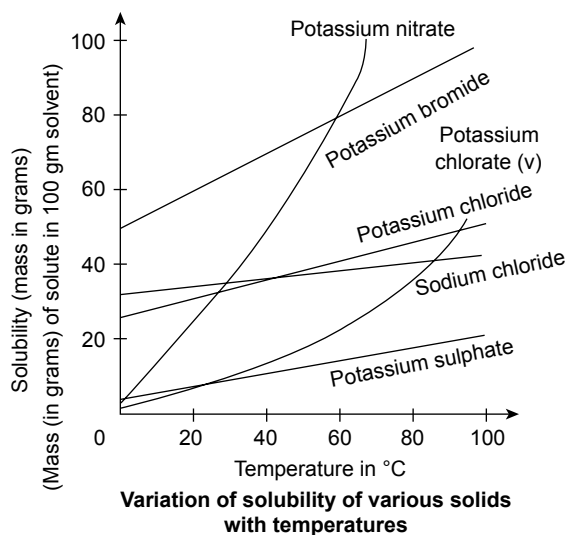
- **Saturated solution:** A solution which contains the maximum amount of solute that can be dissolved in the solvent at a given temperature is called **saturated solution** at that particular temperature.
- **Unsaturated solution:** The solution containing lesser amount of solute than the saturated solution at a given temperature is called an unsaturated solution.
- **Supersaturated solution:** If a solution holds more solute than the saturated solution at a given temperature, it is called a **supersaturated solution**.
- **Factors affecting solubility**

- Nature of solute:** Ionic compounds or polar compounds are more soluble in polar solvents like water. Non-polar compounds are more soluble in non polar solvents like benzene.
- Nature of solvent:** The solvents which have high dielectric constants can dissolve polar and ionic compounds to a greater extent than the solvents with low dielectric constants.

Example: NaCl is highly soluble in water. NaCl is sparingly soluble in benzene.

- Temperature:** For most of the substances, solubility increases with the increase in temperature. However, the solubility of some substances decreases with increase in temperature. In case of some substances, the temperature has no or little effect on the solubility.

- **Solubility curves:** The curves which show variation of solubility with temperature are called solubility curves.



- **Factors affecting solubility of a gas in water**

- Effect of temperature:** With the increase in temperature, the solubility of a gas in a particular liquid decreases.
- Effect of pressure:** The effect of pressure on the solubility of a gas in a liquid is given by Henry's law, which states that at constant temperature the increase in pressure on the surface of the liquid increases the solubility of gas in liquid.

- **Weight percentage (w/w):** The mass of a solute expressed in grams present in 100 grams of a solution is called the weight percentage of the solute in the solution. Weight percentage of the solute

$$= \frac{\text{Weight of the solute}}{\text{Weight of the solution}} \times 100$$

Example: 10% (w/w) sodium hydroxide solution. 10 g of sodium hydroxide is present in 100 g of the solution.

- **Shapes of crystals:** There are seven unique crystal shapes depending on the arrangement of the particles along the three co-ordinate axes.

Shape	Example
Cubic or regular	Diamond, sugar, NaCl
Ortho rhombic	BaSO ₄ , rhombic sulphur
Tetragonal	SnO ₂ , TiO ₂
Monoclinic	Monoclinic sulphur, Na ₂ CO ₃ ·10H ₂ O
Triclinic	CuSO ₄ ·5H ₂ O
Hexagonal	Quartz, graphite
Rhombohedral	CaCO ₃ , HgS

- **Water of crystallization:** When certain salts gets crystallized from its respective hot concentrated aqueous solution, a certain fixed number of water molecules also get attached to the salt to form unit cells of the crystals.
- The fixed number of water molecules which combine with a crystal and are necessary for the maintenance of crystalline properties, but capable of being lost either at normal temperature or at a higher temperature is called water of crystallization. **Examples** of such salts are green vitriol (FeSO₄·7H₂O), blue vitriol (CuSO₄·5H₂O), washing soda (Na₂CO₃·10H₂O) etc.
- **Hydrated salts and anhydrous salts:** The salts which contain water of crystallization are called hydrated salts.
- When the hydrated salts completely lose their water molecules, it is called **anhydrous salt**. For example, CuSO₄·5H₂O is blue in colour. It changes to white colour due to the loss of water molecules on heating.
- **Efflorescence:** There are some hydrated crystals which lose some of the water of crystallization or all the water of crystallization on exposure to air at normal temperature. This phenomenon is known as efflorescence and the hydrated crystals which lose water molecules are called efflorescent substances. An examples of such salt is glauber salt, Na₂SO₄·10H₂O which loses all of its water molecules on exposure to air at ordinary temperature.
- **Deliquescence:** Some crystalline salts absorb moisture on exposure to air and ultimately dissolve in it to form an aqueous solution. This phenomenon is called deliquescence and these crystalline salts are called deliquescent substances. Examples of such salts are hydrated magnesium chloride (MgCl₂·6H₂O), hydrated calcium chloride (CaCl₂·6H₂O) etc.

- **Hygroscopic substances:** There are certain substances which absorb moisture from air without changing their physical state. These substances are called hygroscopic substances. They may exist in solid or liquid state under normal temperature and pressure. Examples of such substances are calcium oxide (solid), concentrated sulphuric acid (liquid) etc.
- **Desiccating agent:** Hygroscopic substances which are used to remove moisture from the surroundings are called desiccating agents. Examples of desiccating agents are calcium oxide and anhydrous calcium chloride.
- A colloid is a mixture where one of the constituents is dispersed evenly throughout another. The size of the constituent particles which is dispersed is in between 10 nm to 1 µm and is called dispersed phase. The medium in which these particles are dispersed is called dispersion medium.
- Classification of colloids

Dispersion medium	Dispersed phase	Example
Solid	Solid	Solid sol - coloured glass
	Liquid	Gel - jelly, cheese, butter
	Gas	Solid foam pumice
Liquid	Solid	Sol - paint, blood
	Liquid	Emulsion-milk, face cream
	Gas	Foam - moisture in air, whipped cream
Gas	Solid	Solid aerosol - smoke
	Liquid	Liquid aerosol - fog, mist, clouds

- **Properties of colloid**
Tyndall effect: When a beam of light rays is passed through a colloid, particles of the dispersed phase scatter the light rays and the path of the light becomes visible. The scattering of light by the colloid particles is known as **Tyndall effect**.
Brownian movement: The random movement exhibited by the colloid particles throughout the dispersion medium is known as **Brownian movement**. This type of movement resists the colloid particles to settle down.
Coagulation of colloid particles: Colloid particles can be coagulated by the addition of salt because these particles are charged. Coagulation takes place due to the neutralization of the charge associated with the colloid particles and thus the colloid particles can be settled down.

Solved Examples

1. Pressure cooker reduces the cooking time. Explain the principle involved.

👉 **Solution:** In a pressure cooker, water is subjected to heating in a closed vessel in confined space. The steam generated in fixed volume increases the pressure beyond the normal atmospheric pressure. Since the external pressure is more, the boiling point of water rises beyond 100°C . The temperature of cooking medium being greater than the normal boiling point, food gets cooked at a faster rate thus saving time and fuel.

2. The critical temperature of gases A, B, C and D are -118°C , -240°C , 132°C and 20°C respectively. Arrange them in the decreasing order of intermolecular force of attraction.

👉 **Solution:** The higher the critical temperature the more is the inter molecular force of attraction and they can be liquefied easily. Decreasing order of intermolecular force of attraction is $\text{C} > \text{D} > \text{A} > \text{B}$.

3. Discuss the change in energy and arrangement of molecules on increasing the temperature of ice from -5°C to 10°C at 1 atm pressure.

👉 **Solution:** When ice is heated at -5°C , its temperature increases upto 0°C that is the kinetic energy of the molecules increases. At 0°C , the ice starts melting. During this process the energy supplied is utilized to increase the potential energy of the molecules keeping kinetic energy

constant, and the arrangement of molecules changes. Once the process ends, the heat supplied is again used to increase the temperature of water by increasing the kinetic energy. However, from 0°C to 4°C , the molecules of water come closer and above 4°C the molecules move farther away.

4. Sodium chloride crystal has a definite shape. Give reason.

👉 **Solution:** The stronger forces of attraction between Na^+ , Cl^- make them remain at their fixed positions, thus arranging in definite pattern to give definite shape.

5. (a) Why does evaporation cause cooling?
(b) Why does the water stored in earthen pots become cool in summer?
(c) Why is drinking of hot tea from a saucer preferred to a cup?

👉 **Solution:** (a) The molecules present on the surface of liquid absorb energy from the liquids inside and go to the vapour state. Thus the temperature of the remaining liquid decreases and hence evaporation causes cooling

(b) Earthen pots consist of pores through which evaporation takes place which causes cooling. Hence water stored in earthen pots becomes cool in summer.

(c) Surface area of milk poured in a saucer is more than that in the cup. The more the surface area, the more is the rate of evaporation which causes cooling. Hence tea present in saucer becomes cool faster than in a cup.

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

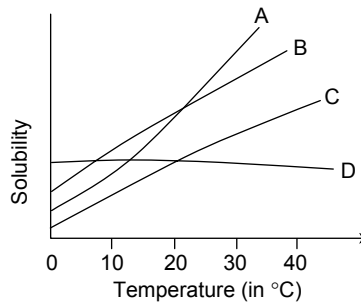
- Maximum intermolecular forces of attraction exist in
 - bromine
 - air
 - oxygen
 - copper
- Among the following, identify the substance in which molecules possess vibratory, rotatory motions and translatory motion, but their movements are not random.
 - Bromine
 - Iodine
 - Ammonia
 - Silicon dioxide
- Liquids be poured easily whereas solids cannot be because of
 - less intermolecular forces of attraction
 - negligible intermolecular space
 - vibratory movement of molecules
 - All the above
- What is the shape of the meniscus observed when water and mercury are taken in two different capillary tubes?
 - Concave and convex
 - Convex and concave
 - Both concave
 - Both convex
- Why does temperature remain constant as heated liquid gets converted to its gaseous state at its boiling point? This is due to the
 - increase in potential energy.
 - increase in kinetic energy.
 - decrease in potential energy.
 - constancy of kinetic energy.
- Cotton clothes preferred in summer because
 - adhesive force between cotton fibre and water is more.
 - cotton is an inorganic material.
 - cotton contains protein molecules.
 - None of these
- Which of the following gases requires the least temperature for liquefaction?
 - Ammonia
 - Helium
 - Hydrogen
 - Nitrogen
- At melting point,
 - kinetic energy remains constant and potential energy increases.
 - kinetic energy increases and potential energy remains constant.
 - both potential energy and kinetic energy increase.
 - potential energy increases with a decrease in kinetic energy
- Identify the given processes (A, B and C).


```

graph TD
    Ice -- C --> WV[Water vapour]
    WV -- B --> Water
    Water -- A --> WV
      
```

 - Sublimation, evaporation and condensation
 - Condensation, evaporation and sublimation
 - Evaporation, condensation and sublimation
 - Sublimation condensation and evaporation
- Fragrance of flowers can be felt as soon as one enters the room because of
 - condensation
 - fusion
 - diffusion
 - solidification
- Dicky, Micky and Vicky had three liquids, A, B and C respectively. They mixed these liquids and observed that they form a homogeneous mixture. They were unable to separate the liquids and asked their teacher to separate these for them. The teacher subjected the given mixture to fractional distillation. Liquid B was obtained in the receiver flask. On further distillation, A was left behind in the distillation flask. On the basis of the results, arrange the critical temperatures of A, B and C in their respective gaseous states in proper order.
 - $A > B > C$
 - $A > C > B$
 - $B > C > A$
 - $C > B > A$
- Which of the following metals can be used for sharp casting?
 - Iron
 - Copper
 - Aluminium
 - Silver

13. In the winter season, when we exhale air early in the morning, it appears foggy. This is due to
- (1) evaporation of water,
 - (2) condensation of CO_2 ,
 - (3) condensation of water vapour,
 - (4) fusion of ice.
14. Small pieces of steel and some powdered rust are taken in two test tubes A and B respectively. When concentrated hydrochloric acid is poured into both the test tubes, a colourless gas is evolved on test tube(s)
- (1) A
 - (2) B
 - (3) Both A and B
 - (4) Neither in A, nor in B
15. How will you separate carbon dioxide, from the mixture of carbon monoxide and carbon dioxide?
- (1) By passing through water under high pressure
 - (2) By passing through concentrated NaOH solution
 - (3) By passing through ammoniacal cuprous
 - (4) All the above
16. Explain how individual gases can be separated from a gaseous mixture of O_2 , H_2 and CO_2 .
- (1) Passing through KOH solution, then diffusion
 - (2) Partial evaporation, then diffusion
 - (3) Preferential liquefaction, then partial evaporation
 - (4) All the above
17. The valency of sulphate radical is equal to the valency of _____ radical.
- (1) phosphate
 - (2) hydrogen phosphate
 - (3) dihydrogen phosphate
 - (4) phosphide
18. Identify the compound in which the total number of constituent atoms present in a molecule is even.
- (1) Ferric oxide
 - (2) Calcium hydrogen sulphide
 - (3) Calcium nitrate
 - (4) Sodium nitrite
19. The ratio of metal atoms to total number of constituents in magnesium phosphate is _____
- (1) 3 : 13
 - (2) 3 : 7
 - (3) 2 : 7
 - (4) 2 : 11
20. Plumbous ion is represented as
- (1) Pb^{+2}
 - (2) Pb^{+4}
 - (3) Pb^{+3}
 - (4) Pb^{+1}
21. Balance the chemical equation given below and identify the coefficients of HCl and Cl_2 .
- $$\text{K}_2\text{Cr}_2\text{O}_7 + \text{HCl} \rightarrow \text{KCl} + \text{CrCl}_3 + \text{H}_2\text{O} + \text{Cl}_2$$
- (1) 3 and 14
 - (2) 14 and 3
 - (3) 7 and 1
 - (4) 8 and 2
22. Identify X in the equation given below.
- $$\text{FeCl}_3 + \text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{FeCl}_2 + \text{HCl} + \text{X}$$
- (1) H_2S
 - (2) SO_3
 - (3) H_2SO_4
 - (4) H_2SO_3
23. For the following reaction, identify the gaseous product formed. $\text{Na}_2\text{CO}_3 + \text{HCl} \rightarrow$
- (1) CO
 - (2) CO_2
 - (3) O_2
 - (4) H_2O
24. A salt contains two atoms of iron, three atoms of sulphur and twelve atoms of oxygen. Identify the corresponding acid and base from which it is formed.
- (1) H_2SO_4 , $\text{Fe}(\text{OH})_2$
 - (2) H_2SO_3 , $\text{Fe}(\text{OH})_2$
 - (3) H_2SO_3 , $\text{Fe}(\text{OH})_3$
 - (4) H_2SO_4 , $\text{Fe}(\text{OH})_3$
25. Identify A, B and the reducing and the oxidizing agents in the following reactions.
- Mg on reaction with CO_2 gives A and gas B.
- (1) MgO, CO, Mg, CO_2
 - (2) Mg, CO_2 , MgO, CO
 - (3) Mg, MgO, CO, CO_2
 - (4) MgO, CO, CO_2 , Mg
26. Colourless solution of silver nitrate is taken in two test tubes A and B. Metal plates of copper and platinum are dipped into test tubes, A and B respectively. Content of test tube
- (1) B turns green
 - (2) B turns blue
 - (3) A turns blue
 - (4) A remains colourless
27. From the given graph, arrange A, B, C, D in the increasing order of solubilities at 30°C .



- (1) CBDA
- (2) BCAD
- (3) ABCD
- (4) DCBA

28. A china dish weighs 25 g when empty. When a saturated solution of potassium chloride is poured into it at 40°C, the weight of the dish is 63 g. When the solution is totally evaporated, the china dish along with the crystals weighs 40 g. Find the solubility of potassium chloride at 40°C.
- (1) 35 (2) 65.2
(3) 39.5 (4) 7.5
29. A salt is formed due to the reaction between an oxy acid containing chlorine and a base containing monovalent metal of atomic mass x . The number of oxygen atoms in one molecule of the acid is more than the corresponding 'ic' acid. Calculate the molecular mass of the salt.
- (1) $83.5 + \frac{x}{4}$ (2) $99.5 + x$
(3) $83.5 + x$ (4) $99.5 + \frac{x}{2}$
30. The formula of hydrogen phosphate of a metal M is $MHPO_4$. Give the formula of metal chloride.
- (1) MCl (2) MCl_3
(3) MCl_2 (4) M_2Cl
31. The ratio of phosphorous atoms present in calcium phosphide and magnesium phosphate is
- (1) 1 : 2 (2) 2 : 1
(3) 1 : 3 (4) 1 : 1
32. Which among the following is not a salt of hydric acid?
- (1) $NaCl$ (2) CaF_2
(3) $MgBr_2$ (4) Na_2SO_4
33. The formula of calcium dihydrogen phosphate is _____.
- (1) $Ca(H_2PO_4)_2$ (2) $Ca(HPO_4)_2$
(3) Ca_3HPO_4 (4) $Ca_3(H_2PO_4)_2$
34. An oxy acid contains three hydrogen atoms, one phosphorus atom and four oxygen atoms. Write the formula of the compound formed by the negative radical of the given acid with ammonium ion.
- (1) $(NH_4)_2PO_4$ (2) NH_4PO_3
(3) MH_4PO_3 (4) $(NH_4)_3PO_4$
35. The ratio of non-metal atoms to the number of atoms of two non-metallic oxides A and B are 0.33 and 0.25 respectively. Find the valencies of non-metals present in those non-metallic oxides.
- (1) 4 and 6 (2) 6 and 4
(3) 2 and 3 (4) 3 and 2

PRACTICE EXERCISE 1 (B)

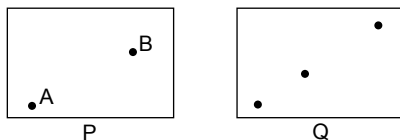
Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

- The high diffusibility of gases is due to
 - high intermolecular forces of attraction
 - high kinetic energy of molecules
 - restricted translatory motion in upward direction
 - All the above
- Identify the crystalline solid among the following.
 - Glass
 - Carbon black
 - Resin
 - Silver
- In a chemistry lab, Rina took some mercury and water in two test tubes A and B respectively. Then she drained off both the liquids and on observing the empty test tubes, found that test tube A is completely dry and some water droplets are stuck to test tube B. What could be the reason for this?
 - Cohesive force between water and glass is more
 - Adhesive force between mercury and glass is more
 - Adhesive force between water and glass is more
 - Cohesive force among mercury atoms are weak
- The diffusibility of which physical state of matter is maximum?
 - Soild
 - Liquid
 - Gas
 - Diffusibilty is independent of physical state
- When two pieces of ice are pressed together they form a single lump. This happens due to
 - liquefication
 - occlusion
 - absorption
 - regelation

6. At Darjeeling, distilled water boils at a temperature
 (1) above 373K (2) above 473K
 (3) below 373K (4) at 373K
7. Which among the following statements is true?
 (1) The rate of evaporation in a coastal area is less because of high humidity.
 (2) The rate of evaporation in a coastal area is more because of presence of water bodies.
 (3) the rate of evaporation is independent of humidity.
 (4) The rate of evaporation is directly proportional to humidity.
8. Arrange the following changes of energy during following phase transition in a proper order.
 Ice (0°C) → water (50°C) → ice (0°C)
 (a) Potential energy increases and kinetic energy remains constant.
 (b) Potential energy decreases and kinetic energy remains constant
 (c) Potential energy increases and kinetic energy increases
 (d) Potential energy decreases and kinetic energy decreases.
 (1) d b c a (2) a c b d
 (3) a c d b (4) c d a b
9. Mention the phase transition based on which the solid room fresheners work.
 (1) Evaporation (2) Condensation
 (3) Occlusion (4) Sublimation
- 10.
- | | Column A | | Column B |
|----|----------|--------|--|
| A. | Solid | () a. | Possesses one free surface, and three types of motions |
| B. | Liquid | () b. | Possesses high kinetic energy and rigid in nature |
| C. | Gas | () c. | Possesses very low kinetic energy and diffusible |
| D. | Melting | () d. | Possesses high kinetic energy and diffusible |
| E. | Freezing | () e. | Possesses very low kinetic energy and rigid in nature |
- f. Potential energy increases and kinetic energy decreases
 g. Potential energy increases and kinetic energy remains constant
 h. Kinetic energy remains constant and potential energy decreases
- (1) A - e, B - a, C - d, D - g, E - h
 (2) A - e, B - f, C - d, D - h, E - c
 (3) A - e, B - a, C - d, D - b, E - f
 (4) A - e, B - d, C - g, D - h, E - c
11. An earthen ware keeps water cool but metallic vessel does not because
 (1) earthen ware has pores.
 (2) metals are good thermal conductor.
 (3) metal wares are heat resistant.
 (4) earthen wares are impervious.
12. Rinku and Pinku had half day schools during summer. They used to go to school by auto. Observed that the auto driver covered the top of the auto by some mats which keeps the auto cool. Which of the following phenomenon is involved here?
 (1) Condensation
 (2) Evaporation
 (3) Sublimation
 (4) Diffusion
13. Can water be made to boil in a paper cup without the paper being burnt. This is because
 (1) temperature of water does not change during boiling.
 (2) ignition temperature of paper is higher than the boiling point of water,
 (3) high latent heat of vaporization of water,
 (4) All the above
14. In cold countries, ethylene glycol is used in car radiators for both winter as well as summer seasons. Which of the following principle is involved here?
 (1) Depression of freezing point
 (2) Elevation of boiling point
 (3) Decrease in rate of evaporation
 (4) All the above
15. Though aluminium is a reactive metal it is still used for packing food articles. Why?

- (1) Strong affinity of aluminium towards O_2
- (2) Strong affinity of aluminium towards N_2
- (3) Aluminium is a light metal.
- (4) None of the above

16. Sample 'X' is a mixture of two liquids A and B. It is subjected to paper chromatography, and gives the chromatogram P. When the same sample is subjected to heating, chromatogram Q is obtained. What do you infer from the two chromatograms?



- (1) B is thermally unstable
 - (2) B has high chemical stability
 - (3) B is converted to A
 - (4) A is converted to B
17. You have been given a powdered mixture of carbon, sulphur and potassium chloride. How will you separate each constituent from the mixture?
- (1) Solvent extraction, solvent extraction, evaporation
 - (2) Evaporation, solvent extraction, filtration
 - (3) Evaporation, filtration, solvent extraction,
 - (4) Solvent extraction, solvent extraction, filtration
18. Why is solid $CaCl_2$ spread on roads in cold countries, during winter season?
- (1) To increase melting the point of ice
 - (2) To decrease the melting point of ice
 - (3) To sublime the ice
 - (4) To reduce the temperature of ice
19. Which one of the following is different from the others with respect to valency?
- (1) Potassium
 - (2) Ammonium
 - (3) Barium
 - (4) Lithium
20. Identify the pair of elements which show variable valency.
- (1) Al, Fe
 - (2) Pb, Sn
 - (3) Sn, Al
 - (4) Pb, Mg
21. The ratio of number of oxygen atoms present in one molecule of ferric oxide to those present in one molecule of calcium sulphate is _____.
- (1) 1 : 4
 - (2) 1 : 1
 - (3) 1 : 3
 - (4) 3 : 4

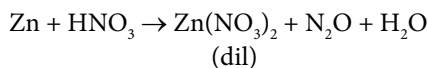
22. Calculate the ratio of the number of metal atoms to the total number of constituents in aluminium carbonate

- (1) 1 : 4
- (2) 7 : 6
- (3) 71 : 6
- (4) 1 : 7

23. Identify the chemical equations which is not balanced.

- (1) $6HNO_3 + S \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$
- (2) $K_2Cr_2O_7 + 6HCl \rightarrow 2KCl + CrCl_3 + 7H_2O + Cl_2$
- (3) $2Ca_3(PO_4)_2 + 6SiO_2 + 10C \rightarrow 6CaSiO_3 + P_4 + 10CO$
- (4) $2KMnO_4 + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$

24. Balance the following reaction and find out the ratio of molar coefficients of the metal and the salt of the metal.



- (1) 1 : 2
- (2) 1 : 1
- (3) 2 : 1
- (4) 1 : 3

25. Which of the following chemical changes represents a displacement reaction?

- (a) A copper coin is placed in a solution of corrosive sublimate, mercuric chloride. The products obtained are cupric chloride and mercury.
- (b) A piece of (a) sulphur, (b) charcoal burns vigorously when dropped in molten potassium nitrate, because potassium nitrate forms potassium nitrite and oxygen and this oxygen helps burn charcoal and sulphur giving out carbon dioxide and sulphur dioxide respectively.
- (c) Aqueous ammonium hydroxide solution is made to react with aqueous copper sulphate solution and a bluish white precipitate of cupric hydroxide and ammonium sulphate are formed.
- (d) Precipitate of cupric sulphide is formed when hydrogen sulphide gas is passed through copper sulphate solution

- (1) a
- (2) b
- (3) c
- (4) d

26. The molecular mass of a salt of oxy acid of chlorine of a divalent metal which contains more number of oxygen atoms than its corresponding '-ic' acid is 239. What is the atomic mass of the metal?

- (1) 24
- (2) 39
- (3) 40
- (4) 30

27. Green coloured ferrous sulphate solution is taken in four beakers, A, B, C and D. Strips of magnesium, zinc, copper and silver are dipped in A, B, C and D respectively. Green colour fades away slowly in two beaker. Identify the beakers.
- (1) A and B (2) C and D
(3) A and C (4) B and D
28. Solubility of salt X in water is 32 at 30°C. Calculate the amount of solvent present in 500 g of saturated solution of X.
- (1) 160 g (2) 340 g
(3) 460 g (4) 68 g
29. Assume that two oxides of a metal contain 25% and 40% of oxygen by weight respectively. Find the ratio of weights of metal combining with fixed mass of oxygen.
- (1) 2 : 1 (2) 1 : 2
(3) 1 : 3 (4) 4 : 1
30. When a soda water bottle is opened, a gas is fizzed out. Which of the following is the correct explanation for the given phenomenon. Solubility of a gas in water is
- (1) directly proportional to temperature.
(2) directly proportional to pressure.
(3) inversely proportional to temperature.
(4) inversely proportional to pressure.
31. Identify the salt of the oxy acid containing the highest number of oxygen atoms associated with that particular non-metal.
- (1) NaNO_2 (2) K_2SO_3
(3) $\text{Ca}(\text{ClO}_4)_2$ (4) NaHPO_3
32. Give the name of the radical with one hydrogen atom, one sulphur atom and three oxygen atoms.
- (1) sulphate (2) sulphite
(3) sulphide (4) bisulphite
33. Identify the incorrect formula among the following.
- (1) $(\text{NH}_4)_2\text{HPO}_4$ (2) PbO_2
(3) CaHSO_4 (4) BaO_2
34. The formula of metal oxide of a metal A is A_2O_3 . Determine the formula of its phosphate.
- (1) A_3PO_4 (2) $\text{A}_2(\text{PO}_4)_2$
(3) $\text{A}(\text{PO})_2$ (4) APO_4
35. Hydrated salts are _____ type of solutions.
- (1) solid-liquid
(2) liquid-solid
(3) solid-solid
(4) solid-gas

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 4	2. 1	3. 1	4. 1	5. 4	6. 1	7. 2	8. 1	9. 2	10. 3
11. 2	12. 1	13. 3	14. 1	15. 4	16. 1	17. 2	18. 4	19. 1	20. 1
21. 2	22. 3	23. 2	24. 4	25. 1	26. 3	27. 4	28. 2	29. 2	30. 3
31. 4	32. 4	33. 1	34. 4	35. 1					

PRACTICE EXERCISE 1 (B)

1. 2	2. 4	3. 3	4. 3	5. 4	6. 3	7. 1	8. 3	9. 4	10. 1
11. 1	12. 2	13. 4	14. 4	15. 1	16. 1	17. 1	18. 2	19. 3	20. 2
21. 4	22. 4	23. 2	24. 2	25. 1	26. 3	27. 1	28. 2	29. 1	30. 2
31. 3	32. 4	33. 3	34. 4	35. 1					

Behaviour of Gases, Mole Concept and Stoichiometry

SYNOPSIS

○ Kinetic molecular theory of gases

1. All gases are made up of tiny particles known as **molecules**.
2. The huge intermolecular spaces make the forces of attraction between the gas molecules negligible.
3. The molecules are in constant random motion. During motion, the molecules collide with each other and also with the walls of the container. These collisions being perfectly elastic transfer of momentum takes place among colliding molecules. The pressure exerted by a gas is due to the collisions of the molecules with the walls of the container.
4. The average kinetic energy of gas molecules is proportional to the absolute temperature of the gas.

- Pressure, temperature and volume are taken as measurable properties of gases
- The S.I units of pressure, volume and temperature are Nm^{-2} , m^3 and Kelvin respectively.
- **Boyle's law:** The volume of a given mass of a gas is inversely proportional to the pressure exerted by the gas at constant temperature.

$$V \propto \frac{1}{P} \text{ (T is constant)} \Rightarrow V = \frac{K}{P}; PV = K \text{ (constant)}$$

- If at constant temperature, a gas occupies a volume V_1 at a pressure P_1 and a volume V_2 at a pressure P_2 , $P_1 V_1 = P_2 V_2$ (T is constant).

- According to Boyles law, $P_1 V_1 = P_2 V_2$

$$\Rightarrow \frac{P_1 m}{d_1} = \frac{P_2 m}{d_2} = \frac{P_1}{d_1} = \frac{P_2}{d_2} \Rightarrow \frac{P}{d} = \text{constant}$$

$$\Rightarrow P \propto d$$

- Charle's law can be stated as the volume occupied by a given mass of a gas is directly proportional to the absolute temperature of the gas at constant pressure.
- If V_1 and V_2 are the volumes occupied by a given mass of gas at temperatures T_1 and T_2 respectively. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (P is constant)
- If the volume is kept constant, increase in temperature results in increase in pressure which is known as **Charles's – Gay Lussac's Law**. $P \propto T$ (Volume is constant). If P_1 and P_2 are the pressures of given mass of gas at temperatures T_1 and T_2 , respectively. $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ (V is constant).
- The lowest temperature that can be attained theoretically is called **absolute zero or zero kelvin**.

- Temperature below 0°C are also possible and they are positive in Kelvin scale. It is not possible to attain a temperature lower than 0K .
- Standard temperature = $0^{\circ}\text{C} = 273\text{K}$; Standard pressure = $760\text{ mm of Hg} = 76\text{ cm of Hg} = 1\text{ atm}$
- Gay-Lussac's law states that when gases chemically react, they do so in volumes which bear a simple whole number ratio to each other and to the volumes of the products, provided the products are also in gaseous state under similar conditions of temperature and pressure.
- Avogadro's law states that equal volumes of all gases contain equal number of molecules under similar conditions of temperature and pressure.
If n is the number of molecules present in volume V of any gas at temperature T and pressure P , then $V \propto n$ when T and P are constant.

$$V = K.n, K \text{ is constant}$$

If at constant temperature and pressure, n_1 molecules of a gas occupies a volume V_1 and n_2 molecules of gas occupies a volume V_2 , then $\frac{V_1}{n_1} = \frac{V_2}{n_2}$.

- Relative molecular mass = $2 \times \text{V.D}$ that is relative molecular mass is twice the vapour density of the gas or vapour.
- Gram molecular volume (GMV): One gram atom or one gram molecule of any gas at STP occupies 22.4 l . This is called Gram molecular volume.
- Scientists experimentally determined that the number of atoms present in 12 g of carbon that is, one gram atom of carbon – 12 isotope is 6.023×10^{23} .
- The avogadro number that is, 6.023×10^{23} is taken as the unit to measure the amount of substances and is called **mole**.
- A mole is defined as the quantity of substance which contains the same number of elementary particles or chemical units as the number of atoms present in 12 g of $\text{C} - 12$ isotope. Hence, 1 mole of any substance contains avogadro number of elementary particles or units. The elementary particles can be atoms, molecules, ions etc.
- Number of moles = $\frac{\text{Mass of substance}}{\text{GMM or GAM}}$
- 1 gram mole of any dry gas occupies 22.4 l volume at STP. Hence 22.4 l of a dry gas at STP contains 6.023×10^{23} molecules that is avogadro number of molecules.
- Combining the three gas laws, that is Boyle's law, Charle's law and Avogadro's law.

$$V \propto \frac{nT}{P} \text{ [when all the functions vary independently]}$$

or $PV \propto nT$ or $PV = nRT$ [R is a constant] A hypothetical gas called ideal gas obeys the equation under all conditions of temperature and pressure. Hence this equation is called **ideal gas equation** and R is called universal gas constant.

- All gases show nearly ideal behaviour under the conditions of low pressure and high temperature and hence are considered as ideal gases. Under the conditions when they deviate from ideal behaviour, they are called **real gases**.
- When one mole of a gas is considered, the equation becomes $PV = RT \Rightarrow R = PV/T$

The value of ' R ' depends upon the units in which pressure and volume are taken. Value of $R \rightarrow 1.987\text{ cal/}^{\circ}\text{C/mole}$ or $8.314 \times 10^7\text{ erg/}^{\circ}\text{C/mole}$ or $8.314\text{ joule/}^{\circ}\text{C/mole}$ or $0.0821\text{ l -atm/}^{\circ}\text{C/mole}$

P_1, V_1, T_1 are initial conditions, P_2, V_2, T_2 are final conditions $\therefore \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

- The total pressure exerted by a mixture of non-reacting gases taken in a container at a given temperature is the sum of the pressures that each gas would exert if it were taken alone in that container. This statement is known as **Dalton's law of partial pressure**.
- **Partial pressure** is the pressure exerted by each constituent of the gaseous mixture when they are kept individually in the same container. If the partial pressures of the constituents of the gaseous mixture are p_1, p_2, p_3, \dots and so on, then according to Dalton's law of partial pressures, the total pressure $P = p_1 + p_2 + p_3 + \dots$
- Partial pressure (p_1) = Mole fraction (n_1/n) \times total pressure of the gas (P)
- **Mole fraction** is the ratio of number of moles of an individual gas to the total number of moles of all gases in a mixture.

Dalton's law of partial pressure is not applicable to gaseous mixture in which the component gases react with each other chemically.

- The number of gas molecules that pass through a unit area in unit time at a given temperature and pressure is called its **rate of diffusion**. In other words, the volume of the gas that diffuses in unit time at constant temperature and pressure is called its **rate of diffusion**.
- According to Graham's law of diffusion, under similar conditions of temperature and pressure, the rates of

diffusion of different gases are inversely proportional to the square root of their densities. That is $r \propto \frac{1}{\sqrt{d}}$

$\therefore \frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$ where r_1 and r_2 are the rates of diffusion of two gases and their molecular mass are M_1 and M_2 respectively.

- **Percentage composition of a compound:** Percentage composition is the mass of each constituent element present in 100 g of a compound. Percentage of an element present in a compound

$$\begin{aligned} & \text{Weight of the element in one} \\ & = \frac{\text{mole of the compound}}{\text{GMM of the compound}} \times 100 \end{aligned}$$

- **Empirical formula** gives the simplest integral ratio of the number of atoms of different constituent elements present in one molecule of the compound. **Molecular formula** represents the exact number of atoms of different elements present in one molecule of the compound.

Molecular formula = Empirical formula \times n

$$\begin{aligned} n &= \frac{\text{Molecular mass}}{\text{Empirical formula mass}}; \text{Molecular mass} \\ &= 2 \times \text{V.D} \end{aligned}$$

- **Molarity:** It is the most convenient and commonly used unit for expressing the concentration of a solution. **Molarity** can be defined as the number of moles of a solute present in one litre of a solution. It is denoted by 'M'.

$$\text{○ } M = \frac{n}{V} = \frac{W}{\text{GMM}} \times \frac{1}{V \text{ in } \ell} \text{ or } M = \frac{W}{\text{GMM}} \times \frac{1000}{V \text{ in ml.}}$$

In case of dilution, $M_1V_1 = M_2V_2$, M_1 and M_2 are molarities before and after dilution respectively.

V_1 and V_2 are volumes before and after dilution respectively.

- Mole fraction of a component in a solution can be defined as the ratio of the number of moles of that component to the total number of moles of all the components of the solution. If 'x' represents mole fraction,

$$x_{\text{solute}} = \frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}}, \quad x_{\text{solvent}} = \frac{n_{\text{solvent}}}{n_{\text{solute}} + n_{\text{solvent}}}$$

where n represents number of moles

The sum of mole fractions of all components in a solution is equal to unity. For a binary solution, $x_{\text{solute}} + x_{\text{solvent}} = 1$

- **Weight percentage (w/W):** The mass of a solute expressed in grams present in 100 g of a solution is called the **weight percentage** of the solute in the solution.

Weight percentage of the solute

$$= \frac{\text{Weight of the solute}}{\text{Weight of the solution}} \times 100$$

- **Weight/volume percentage (w/V):** The mass of a solute expressed in grams present in 100 ml. of a solution is called the **weight/volume percentage** of the solute in the solution.

Weight/volume percentage of the solute

$$= \frac{\text{Mass of the solute (g)}}{\text{Total volume of the solution (ml)}} \times 100$$

- **Volume percentage (v/V):** The volume of the liquid in ml present in a 100 ml solution is called the **volume percentage** of the solute in the solution.

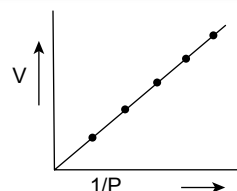
Volume percentage of the solute

$$= \frac{\text{Volume of the solute}}{\text{Volume of the solution}} \times 100$$

- Stoichiometric relationship among the reactants and products can be used for the calculation of quantities of respective substances involved in the reaction.

Solved Examples

1. The slope of a given straight line graph with constant temperature is found to be 0.2 ℓ atm at 5 atmospheric pressure. Calculate the volume of gas at that pressure.



☞ **Solution:** Slope = 0.2 ℓ atm, P = 5 atm.

According to Boyle's law,

$$P \propto \frac{1}{V}, P = \text{constant} \times \frac{1}{V} = \text{slope} \times \frac{1}{V}$$

$$0.2 \times \frac{1}{V} = 5 \times V = \frac{0.2}{5}$$

$$= 0.04 \text{ ℓ}$$

2. A cylinder was filled with a gas at 2 atm pressure at 27°C and can withstand a pressure of 12 atm. At what temperature the cylinder bursts when the building catches fire?

☞ **Solution:** $P_1 = 2 \text{ atm}, P_2 = 12 \text{ atm}$

$$T_1 = 27 + 273 = 300 \text{ K}, T_2 = ?$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow T_2 = \frac{T_1 P_2}{P_1} \Rightarrow T_2 = \frac{12 \times 300}{2} = 1800 \text{ K}$$

$$= 1527^\circ\text{C}$$

∴ Cylinder bursts at or above 1527°C

3. Calculate the weight of

- single atom of nitrogen.
- single atom of carbon.
- 1.5×10^{21} atoms of sodium.
- single molecule of carbon monoxide.

☞ **Solution:** (a) 14 g of nitrogen $\rightarrow 6.023 \times 10^{23}$ atoms

$$x \leftarrow 1 \text{ atom}$$

$$x = \frac{14}{6.023 \times 10^{23}} = 2.3 \times 10^{-23} \text{ g}$$

(b) 12 g of carbon $\rightarrow 6.023 \times 10^{23}$ atoms

$$x \leftarrow 1 \text{ atom}$$

$$x = \frac{12}{6.023 \times 10^{23}} = 2 \times 10^{-23} \text{ g}$$

(c) 23 g of sodium $\rightarrow 6.023 \times 10^{23}$ atoms

$$x \leftarrow 15 \times 10^{21} \text{ atoms}$$

$$x = \frac{23 \times 15 \times 10^{21}}{6.023 \times 10^{23}} = 57.5 \times 10^{-2} = 0.0575 \text{ g}$$

(d) Molecular weight of CO = 12 + 16 = 28

$$28 \text{ g of CO} \rightarrow 6.023 \times 10^{23} \text{ molecules}$$

$$x \leftarrow 1 \text{ molecule}$$

$$\therefore x = \frac{28}{6.023 \times 10^{23}} = 4.6 \times 10^{-23} \text{ g}$$

4. Calculate the number of particles present in

- a sample of bell metal (Cu \rightarrow 80%, Sn \rightarrow 20%) of 100 g mass.
- 2 ℓ of H_2 at 5 atm pressure and 273 °C temperature.

☞ **Solution:** (a) The number of copper atoms

$$\text{present in 100 g of bell metal} = \frac{100 \times \frac{80}{100}}{63.5} \times 6 \times 10^{23} = 7.55 \times 10^{23}$$

The number of tin atoms present in 100 g of bell metal

$$= \frac{100 \times \frac{20}{100}}{118} \times 6 \times 10^{23} = 1.01 \times 10^{23}$$

$$(b) \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \therefore \frac{5 \times 2}{546} = \frac{1 \times V_2}{273} \therefore V_2 = 5 \text{ ℓ.}$$

At STP, 22.4 ℓ H_2 contains 6×10^{23} molecules

At STP 5 ℓ H_2 contains?

$$= \frac{6 \times 5}{22.4} \times 10^{23} \text{ molecules}$$

$$= 1.3 \times 10^{23} \text{ molecules}$$

5. Rate of diffusion of a saturated hydrocarbon is about 1/6th of that of hydrogen under similar conditions of temperature and pressure. What is the molecular formula of that hydrocarbon?

☞ **Solution:** Let the molecular mass of the hydrocarbon be M_x and its rate of diffusion be r_x

$$\frac{r_{\text{H}_2}}{r_x} = \sqrt{\frac{M_x}{M_{\text{H}_2}}}, r_x = 1/6 \text{ } r_{\text{H}_2} \therefore \frac{r_{\text{H}_2}}{r_x} = 6 = \sqrt{\frac{M_x}{2}}$$

$$\Rightarrow 36 \times 2 = M_x \Rightarrow M_x = 72$$

Molecular mass of the saturated hydrocarbon is 72.

Let the number of carbon atoms present in one molecule of the hydrocarbon be m.

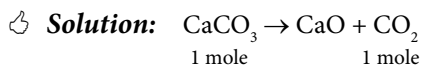
Since the hydrocarbon is saturated, the number of hydrogen atoms present in that hydrocarbon molecule is $2m + 2$

$$\therefore (12 \times m) + (2m + 2) = 72 \Rightarrow 14m + 2 = 72$$

$$\Rightarrow m = 5$$

∴ Molecular formula of the hydrocarbon is C_5H_{12} .

6. Calculate the weight of 80% pure limestone required to produce 11 g of CO_2 gas.



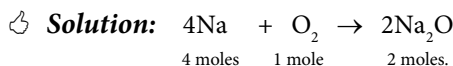
44 g of CO_2 is produced from 100 g of CaCO_3

$$\therefore 11 \text{ g of } \text{CO}_2 \text{ is produced from } \frac{100}{44} \times 11 = 25 \text{ g of } \text{CaCO}_3$$

As the limestone is 80% pure,

$$\therefore \text{The weight of impure limestone required} = \frac{100}{80} \times 25 \text{ g} = 31.2 \text{ g.}$$

7. Calculate the amount of sodium oxide formed when 2.3 g of sodium reacts with 3.2 g of oxygen.



4 × 23 g of sodium reacts with 32 g of O_2 2.3 g of sodium reacts with $\frac{2.3 \times 32}{4 \times 23} = 0.8 \text{ g of } \text{O}_2$

8. Specific gravity of 84% (w/W) pure HNO_3 is 1.54. What volume of HNO_3 is required to prepare one litre of 0.5M HNO_3 solution?

☞ **Solution:** specific gravity of $\text{HNO}_3 = 1.54$

$$M = \frac{w}{\text{GMM}} \times \frac{1000}{V} \times 0.5 = \frac{x}{63} \times \frac{1000}{1000}$$

$$\Rightarrow x = 31.5 \text{ g}$$

31.5 g of HNO_3 is present in 1 ℓ of solution.

84 g is present in 100 g of solution

31.5 g is present in ? g of solution

$$= \frac{31.5 \times 100}{84} = 37.5 \text{ g}$$

$$\text{Density} = \frac{\text{weight}}{\text{volume}} \Rightarrow 1.54 = \frac{37.5}{\text{volume}}$$

$$\Rightarrow V = \frac{37.5}{1.54} = 24.35 \text{ m } \ell$$

24.35 ml of given HNO_3 is required.

9. Calculate the percentage composition of sodium carbonate.

☞ **Solution:** Amount of sodium in 106 g of $\text{Na}_2\text{CO}_3 = 46 \text{ g}$

Amount of sodium in 100 g of Na_2CO_3

$$= \frac{46 \times 100}{106} = 43.39\%$$

Amount of carbon in 106 g of $\text{Na}_2\text{CO}_3 = 12 \text{ g}$

Amount of carbon in 100 g of Na_2CO_3

$$= \frac{12 \times 100}{106} = 11.32\%$$

Amount of oxygen in 106 g of $\text{Na}_2\text{CO}_3 = 48 \text{ g}$

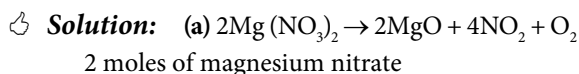
Amount of oxygen 100 g of Na_2CO_3

$$= \frac{48 \times 100}{106} = 45.28\%$$

10. Calculate the volume of gaseous products at STP in the following reactions (for one mole each).

(a) Decomposition of magnesium nitrate.

(b) Decomposition of sodium nitrate.



$\rightarrow 4 \text{ moles } \text{NO}_2 + 1 \text{ mole } \text{O}_2$

1 mole $2\text{Mg}(\text{NO}_3)_2$

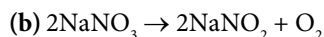
$\rightarrow 2 \text{ moles } \text{NO}_2 + 0.5 \text{ mole } \text{O}_2$

2 moles $\text{NO}_2 \rightarrow 2 \times 22.4 \ell = 44.8 \ell$ volume at STP

0.5 mole $\text{O}_2 \rightarrow 11.2 \ell$ volume at STP

Total volume of gaseous product

$$= 44.8 \ell + 11.2 \ell = 56 \ell$$



2 moles $\text{NaNO}_3 \rightarrow 1 \text{ mole } \text{O}_2$

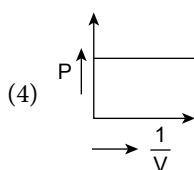
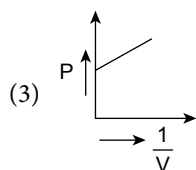
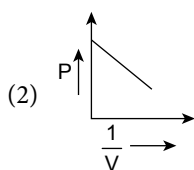
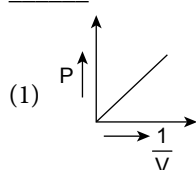
1 mole $\text{NaNO}_3 \rightarrow 0.5 \text{ mole } \text{O}_2$

0.5 mole $\text{O}_2 \rightarrow 11.2 \ell$ at STP

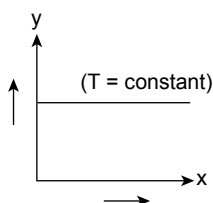
PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 45: For each of the questions, four choices have been provided. Select the correct alternative.

1. The graph of P vs $1/V$ at a constant temperature is _____.



2. If the given graph represents Boyle's law, parameters which are reflected along x axis and y axis are _____ and _____ respectively.



- (1) P, V (2) P, PV
 (3) $P, \frac{1}{V}$ (4) P, V^2
3. The minimum possible temperature is _____.
 (1) 0°F (2) 0°C
 (3) 0K (4) -273K
4. The values of boiling point of water and freezing point of water in Kelvin scale are _____ and _____ respectively.
 (1) $173\text{K}, 273\text{K}$ (2) $273\text{K}, 173\text{K}$
 (3) $273\text{K}, 373\text{K}$ (4) $373\text{K}, 273\text{K}$
5. At absolute zero, gases lose their characteristic properties. Which of the following sequence of explanation is correct for justifying the above fact?
 (a) The value of zero for volume coordinate shows that gases occupy no volume.

- (b) Volume occupied by a gas decreases with decrease in temperature.
 (c) At -273.15°C (absolute zero), the plot of V vs $t^\circ\text{C}$ intersects the temperature axis.
 (d) A gas occupying zero volume means that the matter does not exist in the gaseous state.

- (1) a b c d (2) b a c d
 (3) b c a d (4) d c b a

6. Children brought some balloons each of 2ℓ capacity to a chemist and asked him to fill them with hydrogen gas. The chemist possessed an 8ℓ cylinder containing hydrogen at 10 atm pressure at room temperature. How many balloons could he fill with hydrogen gas at normal atmospheric pressure at the same temperature?

- (1) 40 (2) 36
 (3) 32 (4) 28

7. Calculate the number of molecules present in 16.8ℓ of gas 'X' at STP.

- (1) 1.2×10^{23} (2) 4.52×10^{23}
 (3) 3×10^{23} (4) 6×10^{23}

8. Calculate the volume occupied by 200 g of SO_3 gas at STP.

- (1) 44.8ℓ (2) 33.6ℓ
 (3) 56ℓ (4) 67.2ℓ

9. Calculate the mass of 30.1×10^{23} molecules of carbon dioxide gas.

- (1) 88 g (2) 132 g
 (3) 176 g (4) 220 g

10. STP conditions are _____.

- (1) $273\text{K}, 760\text{ mm of Hg}$
 (2) $-273\text{K}, 760\text{ mm of Hg}$
 (3) $-273\text{K}, 1\text{ mm of Hg}$
 (4) $273\text{K}, 1\text{ mm of Hg}$

11. The volume ratio of SO_2 , O_2 and SO_3 in the reaction for the formation of SO_3 is _____.

- (1) $1 : 2 : 2$ (2) $2 : 2 : 1$
 (3) $2 : 1 : 2$ (4) $1 : 1 : 2$

12. 2 moles of CO_2 gas contains the same number of atoms as _____ moles of CO .

- (1) 0.5 (2) 1
 (3) 2 (4) 3

13. The number of moles of 7 g of nitrogen gas is _____.
 (1) 0.25 (2) 0.5
 (3) 0.75 (4) 1
14. The number of atoms present in 78 g of potassium is equal to the number of potassium ions present in _____ g of potassium chloride.
 (1) 74.5 (2) 37.25
 (3) 223.5 (4) 149
15. 4 moles of oxygen atoms are present in _____ g of NO_2 gas.
 (1) 46 (2) 92
 (3) 69 (4) 23
16. The ratio of the volumes of 11 g of CO_2 and 28 g of CO at STP is _____.
 (1) 1 : 2 (2) 2 : 3
 (3) 3 : 4 (4) 1 : 4
17. 0.5 moles of a salt contains '3N' oxygen atoms. Identify the formula of the salt.
 (1) MXO_3 (2) MX_2O_3
 (3) M_2XO_3 (4) $\text{M}(\text{XO}_3)_2$
18. Identify the chemical equation for which Gay Lussac's law of combining volumes is not applicable.
 (1) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
 (2) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
 (3) $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
 (4) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
19. A gas at a pressure of 2.0 atm is heated from 0°C to 273°C and the volume compressed to $1/4$ th of its original volume. Find the final pressure.
 (1) 12 atm (2) 8 atm
 (3) 16 atm (4) 20 atm
20. A two litre flask contains 22 g of carbon dioxide and 1 g of helium at 20°C . Calculate the partial pressure exerted by CO_2 and He if the total pressure is 3 atm.
 (1) 2.25 atm, 0.75 atm (2) 1.5 atm, 1.5 atm
 (3) 2.5 atm, 0.5 atm (4) 2 atm, 1 atm
21. Dalton's law of partial pressures cannot hold good for
 (1) $\text{NO}_2 + \text{O}_2$ (2) $\text{H}_2 + \text{Cl}_2$
 (3) $\text{CO}_2 + \text{O}_2$ (4) $\text{NH}_3 + \text{He}$
22. Rate of diffusion of gas X is $1/4$ th of rate of diffusion of gas Y. Identify X and Y.
 (1) SO_2, CH_4 (2) CH_4, H_2
 (3) SO_2, He (4) H_2, O_2
23. A solution is prepared by dissolving 9.8 g of H_2SO_4 in 54 g of water. What is the mole fraction of H_2SO_4 ?
 (1) 0.03 (2) 0.04
 (3) 0.01 (4) 0.02
24. What is the percentage by weight of sulphuric acid if 13 g of H_2SO_4 is dissolved to make 78 g of solution?
 (1) 23.4 (2) 20
 (3) 16.6 (4) 13.2
25. If 40 g of ethyl alcohol is dissolved in 50 ml of water, then calculate the weight/volume percentage of ethyl alcohol present in the solution? [Density of ethyl alcohol = 0.8 g/ml]
 (1) 40% (2) 30%
 (3) 25% (4) 35%
26. Semimolar solution contains how many moles of solute in 1 l of solution?
 (1) 1 (2) 0.1
 (3) 0.5 (4) 0.01
27. When 180 g of glucose is subjected to combustion, the volume of CO_2 liberated at STP is
 (1) 22.4 l (2) 67.2 l
 (3) 44 l (4) 134.4 l
28. Which among the following is having maximum molarity?
 (1) 20 g of NaOH in 500 ml solution
 (2) 49 g of H_2SO_4 250 ml solution
 (3) 7.4 g of $\text{Ca}(\text{OH})_2$ in 100 ml solution
 (4) 73 g of HCl in 2000 ml solution
29. The molarity of a 300 ml solution is 0.75 M. The amount of solute present in it is _____ g (molecular mass of solute = 58)
 (1) 13.05 g (2) 12.35 g
 (3) 13.33 g (4) 12.33 g
30. An organic compound contains x% of carbon, y% of hydrogen and the remaining of oxygen. The molecular weight of the compound is given. What sequence of steps is followed for the calculation of molecular formula of the organic compound?
 (a) Calculation of empirical formula weight
 (b) Calculation of simplest ratio by dividing
 (c) Calculation of atomic ratio by dividing the percentages
 (d) Multiplying the empirical formula by the ratio of molecular weight and empirical formula weight

- (1) b a c d (2) c b a d
(3) c b a d (4) d c b a

31. What is the mass of the solvent present in 200 g of 25% (w/W) calcium hydroxide solution?

- (1) 150 g (2) 125 g
(3) 175 g (4) 100 g

32. Calculate the (w/W) % of 10 g of potassium hydroxide in 40 g of solvent.

- (1) 25% (2) 20%
(3) 30% (4) 40%

33. The molarity of a 350 ml solution is 0.5M. Calculate the amount of solute present in it (molecular mass of solute = 98)

- (1) 17.15 g (2) 12.5 g
(3) 16.2 g (4) 13.05 g

34. The specific gravity of sulphuric acid is 1.8. What volume of this sample of concentrated H_2SO_4 is required to prepare 500 ml 0.9M H_2SO_4 solution?

- (1) 23.5 ml (2) 24.5 ml
(3) 25.5 ml (4) 26.5 ml

35. Calculate the mole fraction of glucose in an aqueous solution that contains 45 g of glucose in 45 g of water. Find out the weight of NaOH required to be dissolved in 90 g of water in order to get a solution of the same mole fraction.

- (1) $\frac{1}{11}$, 20 g (2) $\frac{1}{11}$, 10 g
(3) $\frac{1}{10}$, 10 g (4) $\frac{1}{10}$, 20 g

36. The number of constituent particles present in 5 l of air containing 80% N_2 and 20% O_2 by volume at 27°C and 3 atmosphere pressure.

- (1) $\text{N}_2 \rightarrow 1.92 \rightarrow 10^{23}$; $\text{O}_2 \rightarrow 7.68 \rightarrow 10^{23}$
(2) $\text{N}_2 \rightarrow 7.68 \rightarrow 10^{23}$; $\text{O}_2 \rightarrow 1.92 \rightarrow 10^{23}$
(3) $\text{N}_2 \rightarrow 0.75 \rightarrow 10^{23}$; $\text{O}_2 \rightarrow 3 \rightarrow 10^{23}$
(4) $\text{N}_2 \rightarrow 3 \rightarrow 10^{23}$; $\text{O}_2 \rightarrow 0.75 \rightarrow 10^{23}$

37. 4.8 g of magnesium on burning with same amount of oxygen gives magnesium oxide. Calculate the amount of product formed.

- (1) 6 g (2) 4 g
(3) 12 g (4) 8 g

38. A gas cylinder is filled with hydrogen gas which weighs 40 g. The same cylinder holds 880 g of a gas 'A' and 560 g of a gas 'B' under the same conditions of temperature and pressure. Calculate the relative molecular masses of A and B

- (1) $A \rightarrow 44$, $B \rightarrow 28$ (2) $A \rightarrow 32$, $B \rightarrow 64$
(3) $A \rightarrow 46$, $B \rightarrow 28$ (4) $A \rightarrow 44$, $B \rightarrow 32$

39. What is the volume of 50% (w/V) H_2SO_4 required for the liberation of 5.6 l of hydrogen gas at STP on its reaction with magnesium?

- (1) 49 ml (2) 24.5 ml
(3) 98 ml (4) 73.5 ml

40. Calculate the molarity of 30% (w/W) NaOH solution, if the density of the solution is 1.05 g/cc.

- (1) 7.5 M (2) 3.75 M
(3) 7.88 M (4) 3.94 M

41. Identify the compound one mole of which on thermal decomposition liberates different amount of O_2 .

- (1) KMnO_4 (2) KNO_3
(3) KClO_3 (4) H_2O_2

42. A certain mass of gas occupied a volume of 640 ml at a certain temperature and pressure. If the temperature is decreased by 40%, what will be the volume occupied by the same mass of gas under the same pressure?

- (1) 256 ml (2) 1600 ml
(3) 1066 ml (4) 384 ml

43. Calculate the volume of CO_2 formed at STP when 2.32 g of zinc carbonate decomposes with no further loss in weight.

- (1) 0.205 l (2) 0.41 l
(3) 0.82 l (4) 1.23 l

44. One mole of hydrocarbon X is subjected to combustion. The product obtained is condensed and the resulting gaseous product occupied a volume of 89.6 l at STP. Oxygen required for this combustion is 145.6 l at STP. What should be the molecular formula of X?

- (1) C_2H_6 (2) C_4H_{10}
(3) C_3H_8 (4) CH_4

45. Identify the true statements among the following.

- (A) 4 g of helium and 2 g of hydrogen contain the same number of molecules.
(B) If 1.1 g of a gas occupied a 560 ml of volume, its vapour density is 22.
(C) Both 1 mole of sulphuric acid 1 mole of ammonium hydroxide contains the same number of hydrogen atoms.
(D) 48 g of oxygen and ozone occupy same volume under similar conditions.

- (1) (B) and (C) (2) (A) and (B)
(3) (B) and (D) (4) (A) and (D)

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 45: For each of the questions, four choices have been provided. Select the correct alternative.

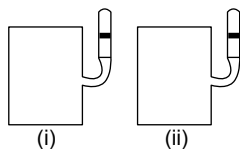
- 5 ℓ of methane gas at 2 atm pressure is compressed to 1.6 ℓ at constant temperature. Calculate the final pressure.
 (1) 0.64 atm (2) 6.25 atm
 (3) 4 atm (4) 16 atm
- The pressure of a certain volume V of gas is reduced to half of its initial pressure at constant temperature. Calculate its new volume.
 (1) 2V (2) $\frac{V}{2}$
 (3) 4V (4) $\frac{V}{4}$
- At a certain pressure, the volume occupied by a given mass of a gas is 10 ℓ at 0°C, calculate the volume occupied by the gas at 91°C at the same pressure.
 (1) 5.83 ℓ (2) 20.8 ℓ
 (3) 7.5 ℓ (4) 13.33 ℓ
- Calculate the temperature at which the volume of a given mass of gas gets reduced to 3/5th of original volume at 10° C without any change in pressure.
 (1) -171° C (2) 513° C
 (3) -198° C (4) -103.2° C
- A certain mass of a gas taken in 1 litre cylinder exerts a pressure of 500 mm Hg at a certain temperature. If the gas is transferred to another cylinder where it exerts 20% more pressure, calculate the volume of the cylinder at the same temperature.
 (1) 1200 cc (2) 833 cc
 (3) 1440 cc (4) 695 cc
- Considering a given mass of a gas by keeping the third variable constant, identify the wrong statements regarding an ideal gas.
 (A) With increase in pressure, volume decreases.
 (B) With increase in temperature, pressure decreases.
 (C) With increase in temperature, volume increases.
 (1) (A) & (B) (2) (B) & (C)
 (3) (A) only (4) (B) only
- How many molecules would be there in 0.01 moles of sodium hydroxide?
 (1) 6.023×10^{23} (2) 6.023×10^{21}
 (3) 6.023×10^{22} (4) 6.023×10^{20}
- Number of moles of calcium ions and phosphate ions present in half mole of calcium phosphate are respectively.
 (1) 3, 2 (2) 2, 3
 (3) 1.5, 1 (4) 1, 1.5
- The volumes of certain gases occupied at STP are given below. Arrange the substances in the increasing order of their weights.
 (a) 22400 cm³ of SO₂
 (b) 224 cm³ of H₂O
 (c) 2240 cm³ of O₃
 (1) a < b < c (2) c < b < a
 (3) b < a < c (4) b < c < a
- What is the volume occupied by 30 g of neon gas at 67°C and 750 mm of Hg?
 (1) 16.72 ℓ (2) 42.43 ℓ
 (3) 8.36 ℓ (4) 21.21 ℓ
- What is the ratio of the rate of diffusion of helium gas to that of oxygen under identical conditions?
 (1) 1 : 8 (2) 8 : 1
 (3) $2\sqrt{2} : 1$ (4) $1 : 2\sqrt{2}$
- Match the items in column I with those in column II.

Column I	Column II
1. 0.01 M solution	A. 1.58 g HNO ₃ in 100 ml
2. 0.25 M solution	B. 0.42 g NaHCO ₃ in 250 ml
3. 0.05 M solution	C. 0.4 g Na OH in 100 ml
4. 0.02 M solution	D. 2.25 g glucose in 250 ml

Which of the following shows correct matching?

- (1) 1 → C; 2 → B; 3 → A; 4 → D
 (2) 1 → B; 2 → A; 3 → D; 4 → B
 (3) 1 → B; 2 → C; 3 → D; 4 → A
 (4) 1 → C; 2 → A; 3 → D; 4 → B
- Asmi and Susmi have taken two containers of same volume attached with two narrow tubes containing small amounts of coloured liquid as shown in the given figures. One container is filled with ideal gas and the other one is filled with real gas. If the number of moles of gases present in two containers are

same and their temperatures are also same, identify the container which contains ideal gas.



- (1) (i) (2) (ii)
(3) both (i) and (ii) (4) can't be predicted

14. A certain amount of oxygen is prepared by the thermal decomposition of potassium chlorate and is collected by downward displacement of water. The pressure of the gas collected is measured with the help of a manometer. The pressure recorded is found to be more than the pressure recorded for the same volume of oxygen cylinder containing same amount of oxygen under the same conditions. How do you account for this deviation?

- (1) Due to the formation of Cl_2 gas during decomposition.
(2) Due to the presence of water vapour along with oxygen.
(3) The temperature of oxygen liberated is relatively high.
(4) All the above

15. Which of the following pairs of gases corresponds to the ratio of the rates of diffusion as $\sqrt{2} : 1$?

- (1) H_2 and He (2) He and CH_4
(3) H_2 and CH_4 (4) CH_4 and SO_2

16. The empirical formula of a compound is CH_2O . If its vapour density is 90, find out the molecular formula of the compound.

- (1) $\text{C}_5\text{H}_{10}\text{O}_5$ (2) $\text{C}_4\text{H}_8\text{O}_4$
(3) $\text{C}_6\text{H}_{12}\text{O}_6$ (4) $\text{C}_3\text{H}_6\text{O}_3$

17. Calculate the weight of zinc required for the liberation of 10 g of hydrogen gas on reaction with H_2SO_4 .

- (1) 655 g (2) 163.7 g
(3) 491.25 g (4) 327.5 g

18. Calculate the weight of sodium bicarbonate to be dissociated to give 0.56 l of CO_2 gas.

- (1) 4.2 g (2) 2.1 g
(3) 1.05 g (4) 3.15 g

19. What is the molarity of a solution containing 15 g of NaOH dissolved in 500 ml. of solution?

- (1) 1 M (2) 0.5 M
(3) 0.75 M (4) 0.25 M

20. What is the percentage by weight of sulphuric acid if 13 g of H_2SO_4 is dissolved to make 78 g of solution?

- (1) 13.2% (2) 14.28%
(3) 20% (4) 16.6%

21. Which of the following is/are consequences of Charles's law?

- (a) Bursting of balloon on blowing it strongly.
(b) Bursting of balloon on its exposure to sunlight.
(c) Expulsion of gas from cooking gas cylinder by keeping cylinder in hot water.
(d) Usage of hot air balloons.
(1) (a), (b), (d) (2) (d) only
(3) (b), (c), (d) (4) (b), (c)

22. Identify the correct statements among the following.

- (a) 32 g of oxygen and 64 g of sulphur dioxide contains the same number of oxygen atoms.
(b) Vapour density of a gas is half of the mass of 11.2 l of gas at STP.
(c) 1 mole of each calcium carbonate and calcium nitrate STP have equal number of oxygen atoms.
(d) 56 g of nitrogen and 56 g carbon monoxide occupy the same volume at STP.
(1) (A) & (C) (2) (A) & (D)
(3) (A), (C) & (D) (4) (B) & (C)

23. Calculate the amount of lime obtained by heating 400 kg of limestone.

- (1) 56 kg (2) 112 kg
(3) 224 kg (4) 280 kg

24. The w/w % of 25 g of calcium hydroxide in 50 g of solvent is _____ %

- (1) 40 (2) 33.33
(3) 36.3 (4) 30

25. The solution of 0.5 moles of NaCl in 1 l solution is called _____ solution.

- (1) molar (2) decimolar
(3) semimolar (4) centimolar

26. What is the molarity of 25% $\left(\frac{w}{V}\right)$ solution of HCl?

- (1) 0.3245 M (2) 3.425 M
(3) 0.685 M (4) 6.85 M

27. Which among the following has minimum molarity?

- (1) 10 g of NaOH in 100 ml solution.
(2) 49 g of H_2SO_4 in 500 ml solution.

- (3) 73 g of HCl in 1000 ml solution.
 (4) 74 g of $\text{Ca}(\text{OH})_2$ in 2000 ml solution.
28. A certain amount of potassium chlorate on thermal decomposition gives oxygen which is sufficient for the combustion of ethane. When the products are cooled, the volume of the gaseous product is v ml. Identify the correct sequence of steps for the calculation of the mass of potassium chlorate.
- Calculation of oxygen required for the combustion of ethane.
 - Calculation of the amount of the ethane subjected to combustion from the volume of gaseous product.
 - Calculation of potassium chlorate which can give the required amount of oxygen.
 - Identification of the products of combustion of ethane and the product left after the cooling of products.
- a b c d
 - d b a c
 - b c a d
 - d a c b
29. In a binary solution, mole fraction of solute is found to be 0.4. What could be the mole fraction of the solvent in the solution?
- 1
 - 0.4
 - 0.6
 - 0.3
30. What is the volume of oxygen liberated at STP when 12.25 g of potassium chlorate is subjected to heating?
- 4.2 l
 - 1.68 l
 - 2.24 l
 - 3.36 l
31. Empirical formula of a compound is $\text{C}_2\text{H}_4\text{O}$. If the empirical formula mass is equal to one half of its vapour density, find out the gram molecular mass of the compound.
- 176
 - 66
 - 44
 - 88
32. A certain mass of a gas occupies a volume of 180 cc at a temperature of 47°C and 2 atm pressure. At what temperature the volume of the same mass of the gas becomes equal to 1000 cc when pressure is changed to 5 atm kept constant?
- 7111 K
 - 1104°C
 - 4444 K
 - 652°C
33. Find out the loss in weight when 75 g of calcium carbonate is subjected to decomposition completely.
- 66 g
 - 22 g
 - 44 g
 - 33 g
34. _____ g of sodium hydroxide is present in 1 litre of 1M solution.
- 20
 - 40
 - 30
 - 10
35. Calculate the mass of water which contains the same number of molecules as that of 667.5 g of aluminium chloride.
- 90 g
 - 72 g
 - 54 g
 - 108 g
36. 480 cc of methane gas diffused in 40 minutes. If 1440 cc of another gas is diffused in 60 minutes under similar conditions of temperature and pressure then find out the gram molecular mass of the gas.
- 28 g
 - 20 g
 - 4 g
 - 32 g
37. Two flasks A and B of equal volumes are kept under similar conditions of temperature and pressure. If flask A holds 16.2 g of gas X while flask B holds 1.012 g of hydrogen, calculate the relative molecular mass of gas X.
- 20 g
 - 32 g
 - 28 g
 - 44 g
38. Empirical formula of a compound is AB_2 . If its empirical formula weight is $\frac{2}{3}$ times of its vapour density, calculate the molecular formula of the compound.
- A_3B_6
 - A_2B_4
 - A_6B_{12}
 - A_4B_8
39. 2 moles of chlorine atoms are present in _____ g of chlorine gas.
- 142
 - 14.2
 - 7.1
 - 71
40. The volume of 8 g of hydrogen gas is _____ cm^3 at STP.
- 67200
 - 56000
 - 89600
 - 78400
41. If gas A diffuses 9 times faster than B, then the ratio of the densities of A and B is _____.
- 9 : 1
 - 1 : 9
 - 81 : 1
 - 1 : 81
42. The weight of 0.5 moles of calcium carbonate is _____.
- 75 g
 - 50 g
 - 100 g
 - 80 g

43. For which of the following reactions, is Gay Lussac's law not applicable?
- (1) Formation of HI from its constituents
 - (2) Formation of NH_3 from its constituents
 - (3) Formation of CO_2 from its constituents
 - (4) Formation of SO_3 from SO_2 and O_2
44. Arrange the relevant points in the proper sequence for explaining why Kelvin scale is preferred to Celsius scale in the study of gases.
- (a) -273°C is the least possible temperature.
 - (b) A graph of volume vs temperature is a straight line passing through origin.
 - (c) A graph of volume vs temperature ($^\circ\text{C}$) is a straight line which intersects volume axis at some point.
 - (d) Extrapolation of straight line touches the volume axis at -273°C
 - (e) -273°C is called absolute zero or 0 K.
 - (f) All values of temperature are positive in Kelvin scale.
 - (g) Usage of negative values for temperature gives negative values for other properties like pressure and volume.
- (1) c d a e f
 - (2) b d a e f
 - (3) c d f e a g
 - (4) b d f e a b
45. Amount of sodium in 1 mole of sodium _____ g
- (1) 23
 - (2) 11.5
 - (3) 34.5
 - (4) 46

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 4 | 5. 3 | 6. 2 | 7. 2 | 8. 3 | 9. 4 | 10. 1 |
| 11. 3 | 12. 4 | 13. 1 | 14. 4 | 15. 2 | 16. 4 | 17. 4 | 18. 1 | 19. 3 | 20. 4 |
| 21. 2 | 22. 3 | 23. 1 | 24. 3 | 25. 1 | 26. 3 | 27. 4 | 28. 2 | 29. 1 | 30. 2 |
| 31. 1 | 32. 2 | 33. 1 | 34. 2 | 35. 1 | 36. 4 | 37. 4 | 38. 1 | 39. 1 | 40. 3 |
| 41. 3 | 42. 4 | 43. 2 | 44. 2 | 45. 2 | | | | | |

PRACTICE EXERCISE 2 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 1 | 3. 4 | 4. 4 | 5. 2 | 6. 4 | 7. 2 | 8. 3 | 9. 4 | 10. 2 |
| 11. 3 | 12. 4 | 13. 1 | 14. 2 | 15. 1 | 16. 3 | 17. 4 | 18. 1 | 19. 3 | 20. 4 |
| 21. 3 | 22. 2 | 23. 3 | 24. 2 | 25. 3 | 26. 4 | 27. 4 | 28. 2 | 29. 3 | 30. 4 |
| 31. 4 | 32. 3 | 33. 4 | 34. 2 | 35. 1 | 36. 3 | 37. 2 | 38. 1 | 39. 4 | 40. 3 |
| 41. 4 | 42. 2 | 43. 3 | 44. 1 | 45. 1 | | | | | |

Atomic Structure

SYNOPSIS

- All types of matter is made up of a large number of tiny indivisible particles known as **atoms**.
- Atom is the smallest particle or unit of matter which takes part in a chemical reaction.
- An atom contains negatively charged particles called electrons embedded uniformly throughout a thinly spread positively charged mass.
- The diameter of the nucleus has been estimated by Rutherford as 10^{-13} cm in contrast to that of an atom to be 10^{-8} cm.
- The electrons present outside the nucleus revolve round the nucleus with high velocities to counterbalance the electrostatic forces of attraction between the nucleus and electrons.
- Rutherford's model of an atom is also called **planetary model**.
- The electron being a charged particle in circular motion, should lose energy. This should ultimately result in its spiral path towards nucleus and the atom should then collapse.
- Energy is emitted or absorbed by the atoms or molecules in the form of packets called **quanta** and is given by $E = h\nu$ where 'h' is Planck's constant and 'ν' is frequency of **radiation**.
 $H = 6.625 \times 10^{-27}$ erg-sec or 6.625×10^{-35} J-sec or 6.625×10^{-34} kg m²s⁻¹

Since $\nu = \frac{c}{\lambda}$ where 'c' is velocity of light and 'λ' is wavelength or radiation.

- **Bohr's model of an atom:** Bohr proposed his atomic model based on the quantum theory of radiation. According to Bohr's model.
- Electrons revolve around the nucleus in specified circular paths called **orbits** or **shells** or **energy levels**.
- Each orbit or shell is associated with a definite amount of energy. Hence these are also called **energy levels** and are designated as K, L, M, N shells respectively.
- The energy associated with a certain energy level increases with the increase of its distance from the nucleus due to decrease in the nuclear force of attraction on the electrons. Hence if the energy associated with K, L, M, N shells are $E_1, E_2, E_3, E_4, \dots$ respectively, then $E_1 < E_2 < E_3 < E_4, \dots$ etc.
- As long as the electron revolves in a particular orbit, the electron does not lose its energy. Therefore, these orbits are called **stationary orbits** and the electrons are said to be in stationary energy states.
- An electron jumps from a lower energy level to a higher energy level, by absorbing energy. It jumps from a higher energy level to a lower energy level, by emitting energy in the form of electromagnetic radiation.

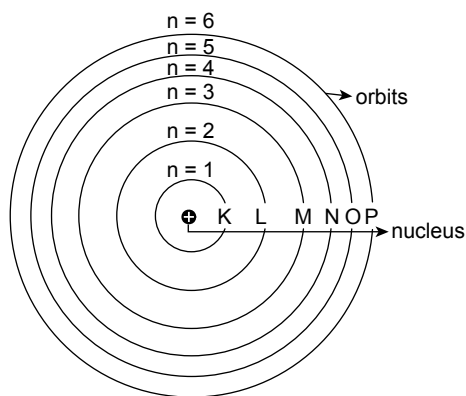
The energy emitted or absorbed (ΔE) is given by Planck's equation that is $\Delta E = h\nu$

For example, if E_1 and E_2 are the energies of the first and the second orbits, the difference in their energies is equal to $h\nu$ that is $E_2 - E_1 = h\nu$.

- Emitted energy when observed under a spectroscope appears as a spectrum consisting of bright lines on a dark background whereas absorbed energy appears as a spectrum consisting of dark lines on a bright background. The former is called **emission spectrum** while the later is called **absorption spectrum**.
- The electron can revolve only in an orbit in which the angular momentum of the electron (mvr) is a whole number multiple of $h/2\pi$. This is known as the principle of quantization of angular momentum. Hence we can write angular momentum of the electron as,

$$mvr = \frac{nh}{2\pi}, \text{ where } n \text{ is an integer } (n = 1, 2, 3, 4, \dots)$$

and is called **principal quantum number**.



Stationary orbits of an atom

m = mass of the electron, v = velocity of an electron in its orbit, r = distance of the electron from the nucleus.

- **Limitations of Bohr's atomic model**
- Bohr could not explain the spectra of the multielectron species satisfactorily.
- Bohr's model couldn't give a satisfactory justification for the assumption that electrons can revolve in those orbits where their angular momentum (mvr) is a whole number multiple of $h/2\pi$ i.e., he could not justify the quantization of angular momentum of the electron.
- According to Heisenberg's uncertainty principle, it is impossible to determine simultaneously and accurately the exact position and the momentum of the moving particle. Bohr assumed that an electron of an atom is located at a definite distance from the nucleus and revolves around the nucleus with a definite velocity which is against Heisenberg's uncertainty principle.

- The atomic spectral lines are found to split into a number of closely packed lines in the presence of a magnetic field and an electric field. These effects are called **Zeeman effect** and **Stark effect** respectively. Bohr failed to explain these effects.
- Each spectral line in the atomic spectrum of hydrogen consists of still finer lines when it is observed by using the instrument with high resolving power. This type of spectrum is known as fine spectrum. Bohr's model failed to explain this observation.
- Arnold sommefeld proposed that the electrons move in an elliptical orbit in addition to the circular orbit around the nucleus with the nucleus at one of the focii. He suggested that the sub energy levels or sub shells associated with each main energy level (the first main energy level) are responsible for the fine structure of the spectrum of hydrogen.
- These sub energy levels or subshells exist due to the difference in energies of electrons revolving in different elliptical orbits belonging to the same main energy level.
- The energy associated with the subshells is quantized and therefore introduced a new quantum number called **azimuthal quantum number** (k) to describe the angular momentum of electrons revolving in different elliptical orbits.

$$mvr = \frac{kh}{2\pi} \text{ (where } k \text{ has values } 1, 2, 3 \text{ etc)}$$

$$n \text{ and } k \text{ are related as, } \frac{n}{k} = \frac{\text{length of major axis}}{\text{length of minor axis}}$$

For a given value of n , the possible values of k are n to 1. When $n = k$, the orbit is circular.

- The principal quantum number determines the energy of the electron and its distance from the nucleus. Its value can be any positive integer. The larger the principal quantum number, the higher is the energy of the electron and the greater is the average distance of the electron from the nucleus. The principal quantum number is denoted by ' n ' where $n = 1, 2, 3, 4, 5 \dots$ or K, L, M, N, O \dots
- The azimuthal quantum number or angular momentum quantum number or subsidiary quantum number determines the shape of the orbitals. The shells are associated with subshells or substates or sublevels. It is denoted by ℓ where the value of ℓ can be any positive integer from 0 to $(n - 1)$ and the total number of sublevels in a shell is equal to its n value.
- The azimuthal quantum number of these 4 subshells are 0, 1, 2 and 3 and they are denoted by letters

s(sharp), p(principal), d(diffuse), f(fundamental) respectively.

- Magnetic quantum number was proposed by **Lande**. The magnetic quantum number was introduced to specify the further subdivisions of subshells or energy sublevels. It describes the spatial orientation of the orbital. The magnetic quantum number is denoted by **m** and have integral values from $-\ell$ to $+\ell$.
- In 1925 **Uhlenbeck and GoudSmit** suggested that electron rotates around its own axis either in a clockwise or in an anti-clockwise direction.

- It is denoted by **s** and can have two values $+\frac{1}{2}$ and $-\frac{1}{2}$. $\left(+\frac{1}{2}\right)$ corresponds to the clockwise spinning of an electron represented by an arrow pointing upwards (\uparrow) and $\left(-\frac{1}{2}\right)$ corresponds to the anticlockwise spinning of electron and represented by an arrow pointing downwards (\downarrow).
- The following table gives the relation among quantum numbers following Pauli's exclusion principle.

Value of Principal quantum number (n)	Value of Azimuthal quantum number (ℓ)	Value of Magnetic quantum number (m)	Value of Spin quantum number (s)	Total number of electrons in main shells
n = 1 (K shell)	$\ell = 0$ s subshell	m = 0	+1/2, -1/2	2 [Note: These two electrons have same n, ℓ and m values but they differ in s value.]
n = 2 (L shell)	$\ell = 0$ s subshell	m = 0	+1/2, -1/2	2
	$\ell = 1$ p subshell	m = -1	+1/2, -1/2	2
		m = 0	+1/2, -1/2	2
		m = +1	+1/2, -1/2	2
				2+6 = 8
n = 3 (M shell)	$\ell = 0$ s subshell	m = 0	+1/2, -1/2	2
	$\ell = 1$ p subshell	m = -1	+1/2, -1/2	2
		m = 0	+1/2, -1/2	2
		m = +1	+1/2, -1/2	2
	$\ell = 2$ d subshell	m = -2	+1/2, -1/2	2
		m = -1	+1/2, -1/2	2
		m = 0	+1/2, -1/2	2
		m = +1	+1/2, -1/2	2
		m = +2	+1/2, -1/2	2
				2
				2
				2
				2+6+10 = 18
n = 4 (N shell)	$\ell = 0$ s subshell	m = 0	+1/2, -1/2	2
	$\ell = 1$ p subshell	m = -1	+1/2, -1/2	2
		m = 0	+1/2, -1/2	2
		m = +1	+1/2, -1/2	2

(Continued)

Value of Principal quantum number (n)	Value of Azimuthal quantum number (ℓ)	Value of Magnetic quantum number (m)	Value of Spin quantum number (s)	Total number of electrons in main shells
	$\ell = 2$	$m = -2$	$+1/2, -1/2$	2
	d subshell	$m = -1$	$+1/2, -1/2$	2
		$m = 0$	$+1/2, -1/2$	2
		$m = +1$	$+1/2, -1/2$	2
		$m = +2$	$+1/2, -1/2$	2
				10
	$\ell = 3$	$m = -3$	$+1/2, -1/2$	2
	f subshell	$m = -2$	$+1/2, -1/2$	2
		$m = -1$	$+1/2, -1/2$	2
		$m = 0$	$+1/2, -1/2$	2
		$m = +1$	$+1/2, -1/2$	2
		$m = +2$	$+1/2, -1/2$	2
		$m = +3$	$+1/2, -1/2$	2
				14
				2 + 6 + 10 + 14 = 32

- **Representation of an orbital:** Since atomic orbital is a three dimensional space which represents the maximum probability of finding an electron, it is difficult to give a pictorial representation of the orbital.
- **An atomic orbital** can be generally represented by a shaded figure where the intensity of shading indicates the probability of finding an electron in that area.
- **s-orbitals:** These orbitals have only one orientation and they are spherical.
- For an s-orbital of n^{th} main energy level, the number of nodal regions is given by $(n - 1)$, where n indicates the main energy level.
- **p-orbitals:** Each p-orbital is dumb-bell shaped with two lobes. The point at which the two lobes meet is called node. There are three orientations for p-orbitals represented as p_x , p_y and p_z . The subscripts x, y and z refer to the co-ordinate axes along which the density of the electrons of the respective orbitals is maximum.
- The probability of finding the electron on the surface between the other two axes is zero. This surface in which the probability of finding an electron is zero is called nodal plane. For example, for p_x orbital, 'yz' is the nodal plane. Each 'p' orbital has one nodal plane, irrespective of the main energy level.
- **d-orbitals:** There are 5 d-orbitals represented as d_{xy} , d_{yz} , d_{zx} , $d_{x^2-y^2}$, d_{z^2} . The orbitals d_{xy} , d_{yz} and d_{zx} have four lobes and these lobes lie symmetrically between the

coordinate axes, for example, the lobes of d_{xy} lie symmetrically in between x and y axes.

The orbital $d_{x^2-y^2}$ also has four lobes along x and y axes. The orbital d_{z^2} has a unique shape with two lobes along z-axis and a 'belt' like space centred in the xy plane. Each d orbital except d_{z^2} has two nodal planes d_{z^2} orbital has conical nodal surface.

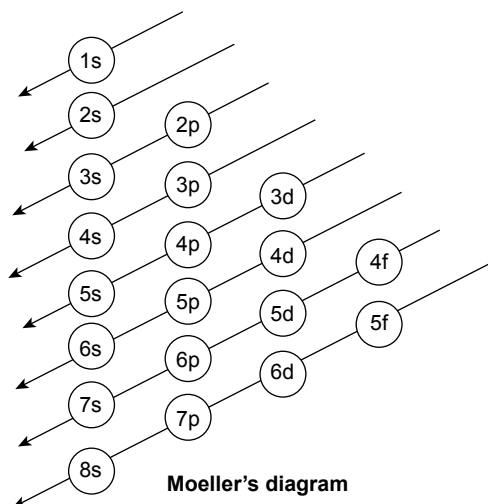
- The distribution of electrons in the different orbitals belonging to different main energy levels of an atom is known as the electronic configuration of the atom of the given element. The electronic configuration of an atom is written in terms of $n\ell^x$ notation where n indicates the main energy level, ℓ indicates the subshells or orbitals (s, p, d, f) and x indicates the total number of electrons present in the subshell.
- The increasing order of the energy of different orbitals belonging to different main energy levels was given by Aufbau principle. According to **Aufbau principle**, "the orbitals are filled up with electrons in the order of their increasing energy". That is the electrons enter into various orbitals in the increasing order of $(n + \ell)$ value.

Example: $(n + \ell)$ value of 1s is $1 + 0 = 1$ and that for the 2s is $2 + 0 = 2$. Hence the electron enters into 1s before entering into 2s.

- In case $(n + \ell)$ value is equal for two orbitals, then the electron enters that orbital, n value of which is less.

For example $(n + \ell)$ value of $3d = 3 + 2 = 5$ and $4p = 4 + 1 = 5$, in this case, the electron prefers to enter the $3d$ orbital.

- The order of filling up of various orbitals can be represented in the form of Moeller diagram.



The increasing order of energies of various orbitals is $1s < 2s < 3p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < \dots$

- Each orbital ($s, p_x, p_y, p_z, d_{xy}, d_{yz}$ etc.,) can accommodate a maximum of two electrons with opposite spin as given by Pauli.
- According to **Pauli's exclusion principle**, it is impossible for two electrons in a given atom to have all the quantum numbers identical. That is two electrons in

an atom can have a maximum of three quantum numbers same but not all the four.

- According to **Hund's rule of maximum multiplicity**, pairing of electrons in a subshell starts when all the degenerate orbitals are filled with unpaired electrons with parallel spin. Hence pairing of electrons in p, d and f subshells start with the introduction of 4th, 6th and 8th electrons respectively. These orbitals are identical in energy in the absence of any electric or magnetic field and are called **degenerate orbitals**.
- Half filled or completely filled subshells impart greater stability to the atoms.

Hence, actual electronic configurations of some transition elements are different from the expected electronic configurations.

Example: Expected electronic configurations of chromium and copper are $3d^4 4s^2$ and $3d^9 4s^2$ respectively. But their actual electronic configurations or **anomalous electronic configurations** are; Chromium: $3d^5 4s^1$ and Copper: $3d^{10} 4s^1$.

- The maximum number of electrons in a main energy level is equal to $2n^2$, where n is the number of the main energy level.
- The maximum number of electrons in a subshell or orbital like s, p, d and f is equal to $2(2\ell + 1)$, where the value of ℓ is 0, 1, 2 and 3 respectively for s, p, d and f orbitals. Hence the maximum number of electrons in s, p, d and f orbitals are 2, 6, 10 and 14 respectively. a new electron enters that orbital where $(n + \ell)$ is minimum.

Solved Examples

1. The atomic mass of an element is 133 and number of neutrons is 41.8% more than number of protons. Find the number of unpaired electrons.

☞ **Solution:** Atomic mass is $= p + n$

$$\text{But } n = p + \frac{p(41.8)}{100}$$

$$\therefore 133 = p + p + p \frac{41.8}{100}$$

$$133 = p \left[2 + \frac{41.8}{100} \right]$$

$$133 = p \left[\frac{241.8}{100} \right]$$

$$\Rightarrow p = \frac{133 \times 100}{242}$$

$$\Rightarrow p = 55$$

Atomic number is 55

\therefore Electronic configuration is $[\text{Xe}] 6s^1$

\therefore Number of unpaired electrons is 1.

2. Copy and complete the following table.

Ratio of electrons In K and N shells	Number of electrons		Number of unpaired electrons	Total number of electron in s, p, d, in orbitals		
	L shell	M shell		s	p	d
1 : 2						
1 : 1						10
1 : 1				8	12	0
1 : 4				9		

Note: 'N' shell need not be the valence shell in all cases

👉 **Solution:**

Ratio	L	M	Unpaired electrons	s	p	d
1 : 2	8	18	2	8	14	10
1 : 1	8	18	0	8	12	10
1 : 1	8	8	0	8	12	0
1 : 4	8	18	1	9	18	10

3. Complete the following table:

Mass number	Number of protons	Number of neutrons	Number of electrons in the ion	Species	Electronic arrangement of element
	8	8	10		
40		20	18		
24	12			Mg ⁺²	

👉 **Solution:**

Mass number	Number of protons	Number of neutrons	Number of electrons in the ion	Species	Electronic arrangement of atom
16	8	8	10	O ⁻²	2, 6
40	20	20	18	Ca ⁺²	2, 8, 8, 2
24	12	12	10	Mg ⁺²	2, 8, 2

4. An element along with its atomic number and mass number is represented as ${}_Z\text{X}^A$ where X is the symbol of the element, Z is the atomic number and A is the mass number. Represent elements A, B, C, D and E with its atomic number and mass number from the given data.

Elements	Number of protons	Number of electrons	Number of neutrons
A		x	y
B	a		b
C		m	m + 2
D		t	t
E	n		n + 1

☞ **Solution:**

Elements	Number of protons	Number of electrons	Number of neutrons	Element can be represented as
A	a	x	y	${}_x\text{A}^{x+y}$
B			b	${}_a\text{B}^{a+b}$
C		m	m + 2	${}_m\text{C}^{2(m+1)}$
D	n	t	t	${}_t\text{D}^{2t}$
E			n + 1	${}_n\text{E}^{2n+1}$

5. The average atomic mass of two isotopes with mass numbers A and A + 2 is A + 0.25. Calculate the percentage abundance of the isotopes.

☞ **Solution:** Let the percentage abundance of the isotope with mass number A + 2 is x.

$$\therefore \frac{(A+2)x + A(100-x)}{100} = A + 0.25$$

$$\Rightarrow 2x + 100A = 100A + 25 \therefore x = 12.5$$

So, the percentage abundance of the isotopes having mass number A and A + 2 are 87.5% and 12.5% respectively.

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

- The angular momentum of an electron in a particular orbit of H-atom is $5.27 \times 10^{-34} \text{ kgm}^2/\text{s}$. Identify the orbit.
 (1) 6 (2) 5
 (3) 3 (4) 4
- Identify the correct relationship regarding energy emitted or absorbed by the atom.
 (1) $E \propto \nu \propto \frac{1}{\lambda}$ (2) $E \propto \lambda \propto \frac{1}{\nu}$
 (3) $E \propto \lambda \propto \frac{1}{C}$ (4) $E \propto C \propto \frac{1}{\lambda}$
- The minimum possible angular momentum of an electron present in an orbital is _____ if the magnetic quantum number associated with this orbital are $-1, 0, +1$.
 (1) $\frac{5h}{2\pi}$ (2) $\frac{3h}{2\pi}$
 (3) $\frac{h}{2\pi}$ (4) $\frac{h}{\pi}$
- For a given ℓ value, the total number of m values are _____.
 (1) $2\ell + 1$ (2) $\ell + 1$
 (3) $2\ell + 2$ (4) $2\ell - 1$
- Which of the following sets of quantum numbers is correct for an electron in 3d orbital?
 (1) 3, 0, 0, $+\frac{1}{2}$ (2) 3, 1, 1, $-\frac{1}{2}$
 (3) 3, 2, 1, $+\frac{1}{2}$ (4) 3, 2, 3, $-\frac{1}{2}$
- The valence electronic configuration of an atom is $6s^2$. If d orbital of the penultimate shell contains two unpaired electrons, calculate the atomic number.
 (1) 72 (2) 48
 (3) 76 (4) 58
- What would be the sum of all four quantum numbers associated with the unpaired electrons present in a nitrogen atom?
 (1) $7\frac{1}{2}$ (2) $8\frac{1}{2}$
 (3) 7 (4) 6
- What is the maximum number of electrons present in the main energy level in which the 'g' subshell appears for the first time?
 (1) 32 (2) 50
 (3) 72 (4) None of the above
- The electronic configuration of vanadium is
 (1) $[\text{Ar}] 3d^4 4s^1$ (2) $[\text{Ar}] 4d^3 5s^2$
 (3) $[\text{Ar}] 3d^3 4s^2$ (4) $[\text{Ar}] 3d^5 4s^0$
- Nitrogen atom has _____ unpaired electrons.
 (1) 1 (2) 2
 (3) 3 (4) 4
- The correct order of energies of orbitals is _____.
 (1) $5s < 7s < 5f < 5d$
 (2) $5s < 5d < 5f < 7s$
 (3) $5s < 5d < 7s < 5f$
 (4) $5f < 5s < 5d < 7s$
- The electronic configuration of dipositive ion is $[\text{Kr}] 4d^{10}5s^25p^2$. Then atomic number of the element is _____.
 (1) 38 (2) 53
 (3) 50 (4) 82
- The electronic configuration of chromium is
 (1) $[\text{Ar}] 3d^5 4s^1$ (2) $[\text{Kr}] 3d^5 4s^1$
 (3) $[\text{Ar}] 3d^4 4s^2$ (4) $[\text{Kr}] 3d^4 4s^2$
- The valence electronic configuration of an element is ns^1 . The element is
 (1) argon (2) sodium
 (3) magnesium (4) fluorine
- The statements given below are the postulates of various atomic models. Arrange them in their chronological order.
 (a) Fine structure is due to the presence of sub shells in the main energy level.
 (b) The size of an atom is much larger than the size of its nucleus.
 (c) As long as the electron is present in a particular orbit, its energy remains constant.
 (d) Negatively charged particles are uniformly spread in the lump of positive charge.
 (1) d c b a (2) b c d a
 (3) d b c a (4) c d b a

16. (a) As long as an electron revolves in a particular orbit, the electron does not lose its energy. Therefore, these orbits are called stationary orbits and the electrons are said to be in stationary energy states.
- (b) Each orbit or shell is associated with a definite amount of energy. Hence these are also called energy levels.
- (c) An electron jumps from a lower energy level to a higher energy level, by absorbing energy. It jumps from a higher energy level to a lower energy level, by emitting energy in the form of electromagnetic radiation.
- (d) Electrons move around the nucleus in specified circular paths called orbits or shells or energy levels and are designated as K, L, M, N shells respectively.

Arrange the above postulates of Bohr's theory in a correct sequence.

- (1) d a c b (2) d b a c
(3) d a b c (4) b d a c

17. The sum of all the quantum numbers of all the valence electrons of an atom of an inert gas is 22. Identify the inert gas.

- (1) Helium (2) Neon
(3) Argon (4) krypton

18. Arrange the following orbitals in the order in which they are filled with electrons and justify the order. 6s, 5d, 6p, 7s, 5f.

- (1) $6s < 5d < 6p < 7s < 5f$
(2) $6s < 6d < 5d < 5f < 7s$
(3) $6d < 5f < 6s < 6p < 7s$
(4) $6s < 7s < 5d < 5f < 6p$

19. Identify the correct statements among the following.

- (A) All orbitals in a shell are degenerate.
(B) Electronic configuration of chromium violates Aufbau principle.
(C) Maximum number of unpaired electrons in 'f' subshell is 7.
(D) maximum number of unpaired electrons in a subshell is $4\ell + 1$.

- (1) A, B, C (2) A, C, D
(3) B, C (4) B, D

20. The isotopes of an element have mass numbers A, A + 1, A + 2. The ratio of abundance of these isotopes is 3 : 2 : 4. Calculate the average atomic mass of the element.

- (1) $A + \frac{1}{10}$ (2) $A + \frac{9}{10}$
(3) $9A + 10$ (4) $10A + 9$

21. Which among the following is true regarding alpha particles?

- (1) They possess low ionizing power.
(2) They possess high penetrating power.
(3) They produce scintillations on fluorescent screen.
(4) Alpha particle is the lightest particle emitted by radioactive substance.

22. Some of the elements have fractional atomic mass. The reason for this could be

- (1) the existence of isobars.
(2) the existence of isotopes.
(3) the nuclear reactions.
(4) the presence of neutrons in the nucleus.

23. Rutherford's atomic model couldn't explain

- (1) the presence of electrons in the atom.
(2) the presence of positive charge in the atom.
(3) the stability of the atom.
(4) the position of the nucleus.

24. A tripositive ion has protons whose mass is equal to 23881 times that of an electron. Identify the element.

- (1) Aluminium (2) Silicon
(3) Magnesium (4) Boron

25. The atomic number of the atom which becomes stable by gaining 3 electrons in 5th shell is

- (1) 56 (2) 49
(3) 51 (4) 54

26. Bohr proposed his atomic model based on

- (1) oil drop experiment.
(2) Planck's quantum theory.
(3) α -ray scattering experiment.
(4) experiments on conduction of gases.

27. The difference in angular momentum of electrons between any two successive orbits in an atom is

- (1) $\frac{h}{2\pi}$
(2) $\frac{2h}{3\pi}$
(3) $\frac{3h}{5\pi}$
(4) Cannot be determined

28. Which of the following could be justified by Bohr's atomic model?
- Stark effect
 - Stability of an atom
 - Quantization of angular momentum
 - Splitting of spectral lines
29. The number of electrons present in the valence shell of an atom with atomic number 38 is
- 2
 - 10
 - 1
 - 8
30. The mass number of an atom whose unipositive ion has 10 electrons and 12 neutrons is
- 22
 - 23
 - 21
 - 20
31. The ratio of atomic numbers of two elements A and B is 1 : 2. The number of electrons present in the valence shell (3rd) of A is equal to the difference in the number of electrons present in the other two shells. Steps involved in the calculation of ratio of number of electrons present in a penultimate shell to antepenultimate shell of B are given below. Arrange them in the correct sequence.
- Calculation of atomic number of B.
 - Calculation of valence electrons present in A.
 - Calculation of atomic number of A.
 - Calculation of number of electrons present in the penultimate shell and antepenultimate shell of B.
- (e) Writing electronic configuration of B.
- b c d a e
 - b c a e d
 - d e b c a
 - d b a c e
32. Predict the possible atomic number(s) of an atom in which the third shell is incompletely filled and maximum 3 more electrons can be added in that shell?
- 12 and 15
 - 15 and 27
 - 27 and 30
 - All the above
33. An electron in 2nd orbit gains energy and goes to 5th orbit. What is the difference in angular momentums in joule sec experienced by the electron due to the transition?
- 3×10^{-32}
 - 5.16×10^{-34}
 - 6.62×10^{-34}
 - 3.16×10^{-34}
34. The atomic masses of two isotopes of an element are 16 and 17 respectively. Their percentage abundances are 25% and 60% respectively and the average atomic mass of the element is 16.90. If the element has 3 isotopes, calculate the atomic mass of the third isotope.
- 17
 - 18
 - 20
 - 15
35. A particular atom has the 4th shell as its valence shell. If the difference between the number of electrons between K and N shell and L and M shell is zero, find the electronic configuration of its stable ion.
- 2, 8, 8, 2
 - 2, 8, 18, 8
 - 2, 8, 8
 - 2, 8

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 35: For the following questions, four choices have been provided. Select the correct alternative.

- According to J.J. Thomson's atomic model, negative charges are embedded in
 - a lump of positive charge.
 - a lump of neutral particles.
 - a lump of small atoms.
 - the nucleus.
- The ratio of the energies of two different radiations whose frequencies are 3×10^{14} Hz and 5×10^{14} Hz is _____.
 - 5 : 3
 - 3 : 5
 - 9 : 25
 - 25 : 9
- The ratio of energy to frequency of a radiation emitted by an electron is equal to _____.
 - wave length
 - velocity of electron
 - bohr's radius
 - Planck's constant
- _____ atomic model introduced the concept of quantization of angular momentum.
 - Rutherford's
 - Bohr's
 - Sommerfeld's
 - Thomson's
- The value of Planck's constant is _____.
 - 6.625×10^{-34} erg sec
 - 6.625×10^{-27} joule sec
 - 6.625×10^{-29} erg. sec
 - 6.625×10^{-34} joule sec

6. Splitting of spectral lines in the presence of electric field is known as _____.
 - (1) Stark effect
 - (2) Zeeman's effect
 - (3) Compton effect
 - (4) Moseley's effect
7. The concept of elliptical orbits was introduced by _____.
 - (1) Rutherford
 - (2) Bohr
 - (3) Sommerfeld
 - (4) Thomson
8. Principal quantum number gives the _____ of an electron and its distance from the nucleus.
 - (1) angular momentum
 - (2) energy
 - (3) velocity
 - (4) centrifugal force
9. If the azimuthal quantum number of an electron is 2 then the shape of orbital is _____.
 - (1) spherical
 - (2) double dumb-bell
 - (3) dumb-bell
 - (4) None of the above
10. The value of ℓ for subshell having five degenerate orbitals is _____.
 - (1) 1
 - (2) 4
 - (3) 3
 - (4) 2
11. When the azimuthal quantum number of an electron is zero, then the shape of its orbital will be
 - (1) circular
 - (2) spherical
 - (3) elliptical
 - (4) dumbbell
12. The maximum number of electrons that can be accommodated in p-subshell is
 - (1) 2
 - (2) 4
 - (3) 6
 - (4) 10
13. Designations of some orbitals are given below. Arrange the orbitals with possible designations in the order in which they are filled with electrons 6s, 8p, 7s, 4d, 2p, 3d, 3f, 4f.
 - (1) $2p < 3d < 4d < 4p < 6s < 8p < 7s$
 - (2) $2p < 3d < 4p < 4d < 6s < 4f < 7s < 8p$
 - (3) $3d < 2p < 4p < 4d < 6s < 4f < 7s < 8p$
 - (4) $2p < 3d < 4p < 4d < 4f < 6s < 7s < 8p$
14. An atom of an element has 3 electrons in 4p subshell. Calculate the atomic number of the element.
 - (1) 31
 - (2) 33
 - (3) 35
 - (4) 34
15. The number of unpaired electrons present in Fe^{+3} is _____.
 - (1) 5
 - (2) 4
 - (3) 3
 - (4) 6
16. The total number of s electrons in vanadium is
 - (1) $[\text{Ar}] 3d^{10}4s^1$
 - (2) $[\text{Ar}] 3d^94s^2$
 - (3) $\{\text{Ar}\} 3d^5 4s^1$
 - (4) $[\text{Ar}] 3d^2 4s^2$
17. The valence electronic configuration of magnesium is _____.
 - (1) $4s^1$
 - (2) $4s^2$
 - (3) $3s^1$
 - (4) $3s^2$
18. _____ subshell has a maximum of 14 electrons
 - (1) s
 - (2) p
 - (3) d
 - (4) f
19. The total number of s electrons in vanadium is
 - (1) 6
 - (2) 8
 - (3) 10
 - (4) 7
20. The pair of orbitals having same $(n + \ell)$ value is
 - (1) 4s, 3p
 - (2) 3d, 4p
 - (3) 6p, 5d
 - (4) All the above
21. X, Y and Z are three atoms belonging to the same element. The atoms have mass numbers in the order $X < Y < Z$. They differ in their number of neutrons by one unit and they exist in the ratio of 1 : 1 : 2. What is the average atomic mass of this element if the atomic mass of the lightest isotope is A?
 - (1) $A + \frac{5}{4}$
 - (2) $A + \frac{4}{5}$
 - (3) $4A + 5$
 - (4) $5A + 4$
22. Among the following, the orbital that has the lowest energy is
 - (1) 5f
 - (2) 4f
 - (3) 6s
 - (4) 6p
23. In which shell d-orbitals appear for the first time?
 - (1) 5th
 - (2) 2nd
 - (3) 4th
 - (4) 3rd
24. Given that the values of principal quantum number and azimuthal quantum number are 3 and 2 respectively, what is the designation of the orbital?
 - (1) 3f
 - (2) 3s
 - (3) 3p
 - (4) 3d
25. Atomic number of an element is 42. Find out the number of electrons present in the valence shell.
 - (1) 1
 - (2) 3
 - (3) 2
 - (4) 4

26. Dipositive helium ions are called _____ particles.
 (1) α particle (2) β particle
 (3) proton (4) γ particle
27. Concept of stationary orbits was introduced by
 (1) Bohr (2) Rutherford
 (3) Sommerfeld (4) Thomson
28. A series of orbitals are given below. Identify the sets which represent the correct order of filling up of orbitals.
 (A) 3s, 3p, 3d, 4s, 4p
 (B) 4s, 4p, 5s, 4d, 5p, 4f
 (C) 2s, 2p, 3s, 3p, 4s, 3d, 4p
 (D) 1s, 2s, 2p, 3s, 3p, 3d
 (1) A and B (2) B and C
 (3) B and D (4) A and D
29. The fundamental particle which has no charge and has mass almost equal to that of positively charged fundamental particle is _____.
 (1) proton (2) neutron
 (3) electron (4) β -particle
30. Identify the sets of electronic transitions associated with release of energy and absorption of energy.
 (A) $n = 4$ to $n = 1$; $n = 2$ to $n = 4$
 (B) $n = 4$ to $n = 3$; $n = 4$ to $n = 2$
 (C) $n = 3$ to $n = 5$; $n = 2$ to $n = 3$
 (D) $n = 3$ to $n = 2$; $n = 1$ to $n = 2$
 (1) A & B (2) B & C
 (3) C & D (4) A & D
31. Which of the following is one of the postulates of Rutherford's theory?
 (1) Electrons continuously lose energy.
 (2) Electrons move in a spiral path around the nucleus.
 (3) Electrons revolve in a specific path around the nucleus.
 (4) Electrons revolve in a stationary orbit.
32. The angular momentum of an electron revolving in second orbit is _____.
 (1) $\frac{h}{2\pi}$ (2) $\frac{h}{3\pi}$
 (3) $\frac{2h}{\pi}$ (4) $\frac{h}{\pi}$
33. The number of electrons present in the penultimate shell of calcium is _____.
 (1) 6 (2) 2
 (3) 8 (4) 7
34. The electron revolves only in the orbits in which
 (1) $mvr > \frac{nh}{2\pi}$ (2) $mvr \geq \frac{nh}{2\pi}$
 (3) $mvr = \frac{nh}{2\pi}$ (4) $mvr < \frac{nh}{2\pi}$
35. Which among the following sets of atomic numbers is/are associated with the increasing order of number of unpaired electrons?
 (A) $Z = 29$; $Z = 20$; $Z = 25$; $Z = 27$; $Z = 20$
 (B) $Z = 20$; $Z = 29$; $Z = 22$; $Z = 27$; $Z = 25$
 (C) $Z = 19$; $Z = 22$; $Z = 24$; $Z = 26$; $Z = 25$
 (D) $Z = 19$; $Z = 22$; $Z = 26$; $Z = 24$; $Z = 25$
 (1) A and C (2) B and D
 (3) A and D (4) B and C

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 1 | 3. 4 | 4. 1 | 5. 3 | 6. 1 | 7. 1 | 8. 2 | 9. 3 | 10. 3 |
| 11. 3 | 12. 3 | 13. 1 | 14. 2 | 15. 3 | 16. 2 | 17. 2 | 18. 1 | 19. 3 | 20. 1 |
| 21. 3 | 22. 2 | 23. 3 | 24. 1 | 25. 3 | 26. 2 | 27. 1 | 28. 2 | 29. 1 | 30. 2 |
| 31. 2 | 32. 2 | 33. 4 | 34. 2 | 35. 3 | | | | | |

PRACTICE EXERCISE 3 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 4 | 4. 2 | 5. 4 | 6. 1 | 7. 3 | 8. 2 | 9. 2 | 10. 4 |
| 11. 2 | 12. 3 | 13. 2 | 14. 2 | 15. 1 | 16. 1 | 17. 4 | 18. 4 | 19. 2 | 20. 4 |
| 21. 1 | 22. 3 | 23. 4 | 24. 4 | 25. 1 | 26. 1 | 27. 1 | 28. 2 | 29. 2 | 30. 4 |
| 31. 3 | 32. 4 | 33. 3 | 34. 3 | 35. 4 | | | | | |

Periodic Classification of Elements

SYNOPSIS

- According to law of triads given by Dobereiner, the elements are grouped into triads in which the atomic weight of the middle element is approximately equal to the average of the atomic weights of the other two elements. He discovered the halogen triad and alkali metal triad consisting of (Cl, Br, I) and (Li, Na, K) respectively and other triad is (Ca, Sr, Ba).
- According to **Law of octaves** given by John Newland the properties of every eighth element is a kind of repetition of the first when arranged in an increasing order of their atomic weights. This classification could hold good only upto atomic weight 40 and failed beyond that.
- **Mendeleeff's Periodic law:** According to this periodic law, if the elements are arranged in the order of their increasing atomic weights, the elements with similar properties are repeated after certain regular intervals.
- Mendeleeff, compiled a periodic table by arranging the then known 63 elements in eight vertical columns called groups and seven horizontal rows known as periods. Later, when the noble gases were discovered, Mendeleeff gave a modified periodic table by including the noble gases in zero group. The groups range from zero to VIII and these, except the zero and eighth group were further subdivided into two subgroups A

and B. He numbered the periods from 1 to 7 of which the 7th period is incomplete.

○ Merits of Mendeleeff's Periodic table

- (i) Mendeleeff left some gaps for some undiscovered elements in the periodic table. The properties of these elements could be predicted based on the properties of other elements present in the same group. He named these missing elements as Eka boron, Eka aluminium and Eka silicon which were later discovered and named as scandium, gallium and germanium respectively.
- (ii) Mendeleeff corrected the doubtful atomic weights of some elements like indium, beryllium and uranium.

○ Demerits of Mendeleeff's Periodic table

- (i) In certain parts of the periodic table, element with a higher atomic weight was placed before that of the lower atomic weight in order to maintain the gradation in properties. These pairs of elements are known as **anomalous pairs**.

Examples:

(a) Ar	39.94	(b) Co	58.93	(c) Te	127.6
K	39.10	Ni	58.7	I	126.9

- (ii) The isotopes of an element have different atomic weights. But there is no position for the isotopes in Mendeleeff's periodic table.

- (iii) The transition triads placed in group VIII of the periodic table should have been given separate positions.
- (iv) Coinage metals were placed along with alkali metals.
- (v) The position of hydrogen is not justified.
- (vi) Two sets of 14 elements each (lanthanides and actinides), which follow lanthanum and actinium in the order of atomic weights, have not been provided regular or separate places in the periodic table.

○ **Modern Periodic Table–Long form of the Periodic Table or Bohr’s Table.**

According to the modern periodic law, when elements are arranged in the increasing order of their atomic numbers, the elements with similar properties are repeated after certain regular intervals.

- The periodic table consists of 7 horizontal rows called periods and 18 vertical columns called groups. The groups are numbered from I to VII and the zero group. The groups from I to VII are further divided into A and B. VIII group consists of 3 vertical columns. All the noble gases are kept in zero group. According to the latest IUPAC recommendation, groups have been numbered from 1 to 18.
- The following table gives a brief description of the seven periods of modern periodic table.

Period	Description
1	This is a very short period consisting of only two elements, hydrogen and helium. These elements have only one shell.
2	This is a short period . It has 8 elements from Li to Ne. These are called bridge elements . These elements have two shells.
3	This is also a short period . It has 8 elements from Na to Ar. These are called typical elements . These elements have three shells.
4	This is a long period . It has 18 elements from K to Kr. It consists of first transition series elements, that is, from Sc to Zn.
5	This is a second long period . It has 18 elements from Rb to Xe. It consists of second transition series elements, that is, from Y to Cd.
6	This is a very long period . It has 32 elements from Cs to Rn. It consists of third transition series elements, that is, from La to Hg and also, the 14 elements of first innertransition series, that is from Ce to Lu.

Period	Description
7	This is an incomplete period . These elements are radioactive. The elements succeeding uranium are all artificial elements. These are called transuranic elements . This period includes the elements of fourth transition series which is incomplete and the 14 elements of second innertransition series, that is, from Th to Lr.

- The regular gradation and repetition of properties of the elements is called **periodicity** and the properties which show such regular trend are called **periodic properties**.
 - **Valency and valence electrons:** Valency gives the combining capacity of an element. It depends on the number of electrons in the outermost shell of an element called **valence electrons**. In case of metals, the valency is equal to the number of valence electrons and in case of non-metals, the valency is equal to the number of valence electrons or 8-number of valence electrons. According to old notation of group numbers, in representative elements, group number signifies the number of valence electrons.
 - **Variation of valence electrons and valency**
 - (i) **Period:** The number of valence electrons increases from left to right along the period but valency increases from 1 to 4 and then decreases to 1. The valency of noble gases is zero.
 - (ii) **Group:** On moving down the group, the valence electrons and hence valency remains the same.
 - **Atomic size:** Atomic size is the distance between the centre of the nucleus and the valence shell.
 - **Variation of atomic size**
 - (i) **Period:** The atomic size generally decreases from left to right along the period. This is because along a period the electrons are added to the same energy level, which leads to an increase in the effective nuclear charge on the outermost shell, thereby decreasing the size of the atom.
- Exception:** In the noble gases, due to interelectronic repulsions, and their inability to form bonds the atomic size measured is more than that of the corresponding halogen.
- (ii) **Group:** On going down the group, a new shell is being added from one element to the other. Therefore the effective nuclear force of attraction on the valence shell decreases, thereby increasing the size of the atom.

Exception: Atomic sizes of 6th period elements do not show much increase from the corresponding 5th period elements of same groups. This is because of the addition of 14 electrons to the antepenultimate 'f' sub shell of lanthanide elements. The contraction in atomic size among lanthanide elements is called **lanthanide contraction**.

- **Ionization energy or Ionization potential:** Ionization energy of an element is the minimum amount of energy required to remove the most loosely held electron from the outermost shell of an isolated neutral gaseous atom of that element in its lowest energy state to form a cation. This is called the **first ionization potential**.

The **second ionization potential** is the energy required to remove the electron from the outermost shell of a unipositively charged gaseous ion. Similarly, we can define the third, and the fourth ionization energies or ionization potentials. If the first ionization energy is considered as I_1 and the second as I_2 and so on then, $I_1 < I_2 < I_3 < I_4 < \dots$. This successive increase in the values of ionization potential is due to the increase in effective nuclear charge from the neutral atom to the respective ions.

- **Variation of ionization potential**

- (i) **Period:** Ionization energy generally increases from left to right along a period. This is because along a period, the atomic size decreases and the valence shell is closer to the nucleus. Thus more energy is required to remove an electron from the valence shell.
- (ii) **Group:** The ionization energy decreases from top to bottom in a group because the atomic size increases down the group, thus resulting in decrease in the effective nuclear force of attraction.

- **Electron affinity:** The amount of energy released when an electron is added to an isolated neutral gaseous atom in its lowest energy state to produce an anion is called the **electron affinity**.

- **Variation of electron affinity**

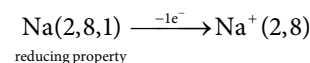
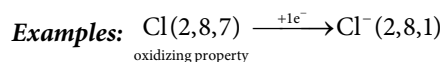
- (i) **Period:** As the atomic size decreases and nuclear charge increases from left to right across the period, the electron affinity values generally increase.
- (ii) **Group:** The electron affinity gradually decreases from top to bottom due to the steady increase in atomic size and the resultant decrease of effective nuclear charge.

- **Electronegativity:** **Electronegativity** of an element is defined as the tendency of an atom to attract the shared pair of electrons towards itself in a bonded molecule.

- **Variation of electronegativity**

- (i) **Period:** Electronegativity increases along a period from left to right. This is due to the increase in nuclear charge and decrease in atomic size.
- (ii) **Group:** Electronegativity decreases from top to bottom in a group due to an increase in the atomic size.

- **Oxidizing and reducing property:** **Oxidizing property** is the property of an element by virtue of which it accepts one or more electrons from the other. On the other hand, **reducing property** of an element is the property of an element by virtue of which it give one or more electrons to the other.



- **Variation of oxidizing and reducing properties**

- (i) **Period:** Due to the increase in electron affinity from left to right along a period, the oxidizing property of the elements increases and the reducing property decreases from left to right along a period.
- (ii) **Group:** Due to the decrease in ionization energy as well as electron affinity from top to bottom of a group, oxidizing property of the element decreases and reducing property increases on descending a group.

- **Metallic and non-metallic property:** Metals can generally give away electrons easily and form positive ions while non-metals generally accept electrons and form negative ions.

- **Variation of metallic and non-metallic properties**

- (i) **Period:** As the electronegativity increases from left to right along a period, the metallic character decreases and the non-metallic character increases.
- (ii) **Group:** As the electronegativity decreases from top to bottom in a group, the metallic character increases and non-metallic character decreases.

- **Nature of oxides of the elements and chemical bonding:** Generally, metals form basic oxides and non-metals form acidic oxides. However, oxides of some metals are amphoteric in nature as they react with both acids and bases.



Oxides of some non-metals are neutral in nature as they react with neither acids nor bases.



Basic and acidic nature of oxides of the elements depends on their metallic and non-metallic character respectively. The element with more metallic character forms the oxide which is more basic in nature and the element with more non-metallic character forms the oxide which is more acidic in nature.

- **Chemical reactivity of the elements:** Chemical reactivity of elements is the tendency of the elements to involve in bond formation.

- (i) **Period:** Along a period the chemical reactivity of elements gradually decreases upto IVA or 16th group and then increases upto VIIA or 17th group. Noble gases are chemically inactive.
- (ii) **Group:** As one moves down a group, the chemical reactivity of elements gradually increases in the case of metals and decreases in the case of non-metals.

Solved Examples

1. What are the basic differences between Mendeleev's periodic table and modern periodic table?

☞ **Solution:** (i) Mendeleev's periodic table was based on atomic weight whereas modern periodic table was based on atomic number.

(ii) Mendeleev's periodic table consists of 8 groups and 7 periods whereas modern periodic table consists of 18 groups and 7 periods.

2. In the modern periodic table, magnesium is surrounded by elements with atomic numbers 4, 11, 13 and 20. Identify the elements. Which of these have chemical properties resembling magnesium?

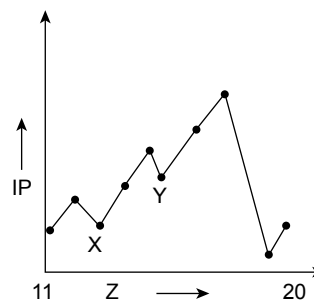
☞ **Solution:** The element $_{12}\text{Mg}$ is present in the centre of the elements having atomic numbers 4, 11, 13 and 20. The atomic number 4 and 20 resemble magnesium because they belong to same group having same number of valence electrons.

	Be = 4 (2, 2)	
Na = 11 (2, 8, 1)	Mg = 12 (2, 8, 2)	Al = 13 (2, 8, 3)
	Ca = 20 (2, 8, 8, 2)	

3. How was the problem of placement of isotopes in Mendeleev's periodic table overcome in modern periodic table?

☞ **Solution:** Modern periodic table was based on the atomic number. Since isotopes have similar atomic numbers, the problem of placement of isotopes was solved.

4. Teacher explained periodicity of ionization potential in a period and group with reasons. She then drew a curve of IP vs atomic number for elements with $Z = 11$ to $Z = 20$. On the basis of the curve, she asked the following questions to students.



- (a) Identify the elements occupying peaks and bottommost points.
(b) Also identify 'X', and 'Y' marked in the curve.

☞ **Solution:** (a) Peak is occupied by noble gas, Ar. Bottom most point is occupied by alkali metal, K.
(b) 'X' is aluminium and 'Y' is sulphur

5. Ionization energy is the energy absorbed whereas electron affinity is the energy released. Explain.

☞ **Solution:** When an electron is present in the outermost shell of an atom, it is bound by nuclear force of attraction. In order to remove this electron, some amount of energy should be supplied to overcome the nuclear force of attraction. During the addition of an electron to a neutral atom, the electron approaches to a neutral atom due to nuclear force of attraction. This process involves work done towards the force of attraction and hence energy is released. Thus, ionization

potential is the energy absorbed and electron affinity is the energy released.

6. The atomic number of elements A, B and C are $(Z - 1)$, Z and $(Z + 1)$ respectively. B is an inert gas (not helium). Answer the following.

- Predict the groups to which A and C belong.
- Which element has the highest ionization energy? Why?
- Which element has the lowest ionization energy? Why?

👉 **Solution:** (a) A and C belong to VIIA group and IA group respectively.

(b) Element B has the highest ionization energy, because it is a noble gas having stable octet configuration.

(c) Element C has the lowest ionization energy, because it is an alkali metal and the number of shells are more as compared to A and B and therefore nuclear force of attraction is less.

7. A sharp change in the atomic radius is observed from lithium to potassium but a gradual change in the atomic radius is observed from potassium to caesium. Explain.

👉 **Solution:** A sharp increase in the atomic radius is observed from lithium to potassium due to increase in the number of shells. But a gradual change is observed from potassium to caesium due to filling up of d electrons, in the penultimate shell which increases the effective nuclear charge. Hence increase in size is gradual, not sharp.

8. The ionic size of Cl^- is greater than that of K^+ ion, though they are isoelectronic. Explain.

👉 **Solution:** Nuclear forces of attraction on valence electrons is higher in K^+ ion, than in that in Cl^- ion. So ionic size of Cl^- ion is greater than that of K^+ ion.

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

- If three elements X, Y and Z form a Dobereiner's triad and atomic weights of X and Z are 9 and 40 respectively, then the atomic weight of the element Y is approximately _____.
 (1) 24.5 (2) 49
 (3) 34.5 (4) 29
- The element in between lithium and potassium in Dobereiner's classification is _____.
 (1) Mg (2) Na
 (3) Ca (4) Rb
- The anomalous pairs in Mendeleeff's periodic table is/are _____.
 (1) Co, Ni (2) Te, I
 (3) Ar, K (4) All the above
- The elements A and B obey law of octave. How many elements are there between A and B?
 (1) 7 (2) 8
 (3) 5 (4) 6
- Chlorine, Y and Iodine form a Dobereiner's triad. Identify the atomic weight of Y.
 (1) 162.5 (2) 81.25
 (3) 121.5 (4) 90.5
- Three elements X, Y and Z form a Dobereiner triad. The ratio of the atomic weight of X to that of Z is 7 : 25. If the sum of the atomic weights of X and Z is 160, find the atomic weights of X, Y and Z.
 (1) $X \rightarrow 35, Y \rightarrow 80, Z \rightarrow 125$
 (2) $X \rightarrow 125, Y \rightarrow 80, Z \rightarrow 35$
 (3) $X \rightarrow 80, Y \rightarrow 35, Z \rightarrow 125$
 (4) $X \rightarrow 80, Y \rightarrow 125, Z \rightarrow 35$
- The atomic number of an element that belongs to the IVA (or 14) group and 4th period is
 (1) 32 (2) 30
 (3) 34 (4) 36
- In the modified Mendeleeff's periodic table, _____ groups and _____ periods are present, whereas in modern periodic table, _____ groups and _____ periods are present, respectively.
- Extremely electropositive metals are present in _____ and _____ groups.
 (1) IIA and IIIA
 (2) IA and IIA
 (3) IIIA and IVA
 (4) IVA and VIIA
- The characteristics of hydrogen resemble the elements of _____ as well as _____ groups.
 (1) IIA and VA (2) IIIA and VIA
 (3) IIA and VIA (4) IA and VIIA
- Element X has twelve protons in its nucleus. To which group in the periodic table would it belong?
 (1) IVA (14) (2) IIA (2)
 (3) IIIA (13) (4) VIA (16)
- The first and second ionization energies (KJmol^{-1}) of three elements A, B and C are given below.

	A	B	C
IE_1	402	650	1140
IE_2	2642	1060	2070

Identify the element which is likely to be a non-metal.

- A (2) B
 (3) C (4) Can't be predicted
- Most of the innertransition elements exist as stable tripositive ions due to the loss of electrons present
 (1) in p-orbital and s-orbital of valence shell.
 (2) in s-orbital of valence shell and d-orbital of penultimate shell.
 (3) in p-orbital of valence shell and d-orbital of penultimate shell.
 (4) in s-orbital of valence shell and f-orbital of anti penultimate shell.
- "An element X has two electrons in its valence shell without any core electrons. Identify the group to which it belongs".
 (1) 2nd (2) 18th
 (3) 12th (4) 8th

15. Arrange the following oxides in the increasing order of acidic nature.
 SiO_2 , Cl_2O_7 , SO_2 and P_2O_5 .
 (1) $\text{SiO}_2 < \text{P}_2\text{O}_5 < \text{Cl}_2\text{O}_7 < \text{SO}_2$
 (2) $\text{SO}_2 < \text{Cl}_2\text{O}_7 < \text{P}_2\text{O}_5 < \text{SiO}_2$
 (3) $\text{Cl}_2\text{O}_7 < \text{SO}_2 < \text{P}_2\text{O}_5 < \text{SiO}_2$
 (4) $\text{SiO}_2 < \text{P}_2\text{O}_5 < \text{SO}_2 < \text{Cl}_2\text{O}_7$
16. An element 'X' belong to the fourth period and IIB(3) group. To which block in the periodic table would it belongs?
 (1) s-block (2) f-block
 (3) p-block (4) d-block
17. Elements A, B and C with atomic numbers z , $z + 1$, $z + 2$ form positive ions having equal number of electrons. Compare and contrast the sizes of the respective ions.
 (1) $A^{+1} > B^{+2} > C^{+3}$ (2) $A^{+1} > C^{+3} > B^{+2}$
 (3) $B^{+2} > A^{+1} > C^{+3}$ (4) $C^{+3} > A^{+1} > B^{+2}$
18. Successive ionization potentials of a metallic element 'M' are 520 kJ, 7300 kJ, 10100 kJ, 13500 kJ respectively. Identify the formulae of compounds when it combines with non-metals X and Y. 'X' contains 7 electrons in valence 'M' shell and 'Y' contains 6 electrons in valence 'N' shell.
 (1) M_2X , MY (2) MX_2 , MY_2
 (3) MX , MY (4) MX , M_2Y
19. Name the elements with minimum electronegativity and maximum oxidizing power in the periodic table.
 (1) Li, F (2) Li, I
 (3) CS, F (4) CS, I
20. What are the valencies of Si and Cl with atomic numbers 14 and 17 respectively?
 (1) 3, 2 (2) 4, 2
 (3) 2, 3 (4) 4, 1
21. An element R belongs to IVA(14) group and 3rd period in the periodic table. Arrange the elements that are placed below 'R' in increasing order of atomic size.
 (1) $\text{Ge} > \text{Sn} > \text{Pb}$ (2) $\text{As} > \text{Sb} > \text{Bi}$
 (3) $\text{Ge} < \text{Sn} < \text{Pb}$ (4) $\text{As} < \text{Sb} < \text{Bi}$
22. Arrange the elements S, N, Be, Mg and Al in the increasing order of their atomic size.
 (1) $\text{N} < \text{Be} < \text{Al} < \text{Mg} < \text{S}$
 (2) $\text{Be} < \text{N} < \text{Al} < \text{S} < \text{Mg}$
 (3) $\text{N} < \text{S} < \text{Be} < \text{Al} < \text{Mg}$
 (4) $\text{N} < \text{Be} < \text{S} < \text{Al} < \text{Mg}$
23. Elements belonging to which group have the largest atomic radii?
 (1) IA (2) IIA
 (3) VIIA (4) 0
24. If I_1 is the 1st ionization potential, I_2 is the 2nd ionization potential, I_3 is the 3rd ionization potential and I_4 is the fourth ionization potential of an element, then which of the following has the least value?
 (1) I_1 (2) I_2
 (3) I_3 (4) I_4
25. The difference in the number of valence electrons of 'zero' (18) group element and IIA (2) group element is equal to the number of valence electrons of _____.
 (1) group VIA (16) (2) group IIIA (13)
 (3) group VA (15) (4) group IVA (14)
26. The oxidizing and reducing property across period
 (1) increases and decreases respectively
 (2) decreases and increases respectively
 (3) both increases
 (4) both decreases
27. Among the elements Si, P, S and Cl, _____ has the highest ionization energy.
 (1) Si (2) S
 (3) P (4) Cl
28. Arrange the following statements in a chronological order.
 (a) Some elements be grouped in sets of three elements in the increasing order of their atomic weights in which the atomic weight of the middle element was found to be the arithmetic mean of the atomic weights of the other two elements.
 (b) The physical and chemical properties of elements are periodic functions of their atomic numbers.
 (c) The physical and chemical properties of elements are periodic functions of their atomic weights.
 (d) When elements are arranged in the increasing order of their atomic weights, the eighth element resembles the first in physical and chemical properties just as the eighth note on a musical scale resembles the first one.
 (1) a d c b (2) a c d b
 (3) d b a c (4) b d c a

29. The electron affinity increases on moving from left to right along a period. Arrange the reasons in a proper sequence.

- (a) The amount of energy released during the addition of an electron increases from left to right along a period.
- (b) Effective nuclear charge of the elements increases from left to right.
- (c) The atomic size of the elements decreases from left to right.
- (d) The tendency to gain electrons and form anion increases from left to right.

- (1) a c b d (2) b c d a
(3) c a d b (4) d c b a

30. X belongs to IA or 1st group and 5th period and Y succeeds X in the group. Z succeeds Y in the period. Arrange the following statements in the correct sequence in order to arrange X, Y and Z in the increasing order of their atomic sizes.

- (a) Effect of number of valence electrons and number of shells on the atomic size.
- (b) Identification of the elements X, Y, Z.
- (c) Determination of the number of shells and the number of valence electrons present in X, Y and Z.
- (d) Determination of the positions of Y and Z in the periodic table based on the position of X.

- (1) d b c a (2) b d c a
(3) c a d (4) d c a

31. From the set of elements given below, identify the correct order of electron affinities of the elements.

- (a) $\text{Be} > \text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$
- (b) $\text{F} > \text{Cl} > \text{Br} > \text{I}$
- (c) $\text{Be} > \text{B} > \text{C} > \text{N} > \text{O}$
- (d) $\text{Cl} > \text{F} > \text{Br} > \text{I}$

- (1) a and b (2) b and c
(3) a and d (4) c and d

32. Identify the correct alternative from the following set of properties that increase down the group.

- (a) Atomic radius
- (b) Ionization potential
- (c) Electron affinity
- (d) Electropositivity
- (e) Oxidizing property
- (f) Reducing property

- (1) a, b and c (2) c, d and e
(3) b, c and e (4) a, d and f

33. Identify the correct sets of entries that are rightly matched.

Column A	Column B
(A) Bridge elements	(a) Elements of group IA-VIIA
(B) Representative elements	(b) 2nd period elements
(C) Typical elements	(c) 7th period elements
(D) Transition elements	(d) 3rd period elements
(E) Transuranic elements	(e) Present in 4th, 5th and 6th periods

- (i) A-b, C-d, E-c (ii) A-a, B-b, C-c
(iii) B-a, D-e, E-c (iv) D-d, E-e, B-a
(1) (i) and (iii) (2) (ii) and (iv)
(3) (i) and (iv) (4) (ii) and (iii)

34. Pick the correct order of ionization potential values of elements.

- (a) $\text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$
- (b) $\text{He} > \text{Ne} > \text{Ar} > \text{Kr} > \text{Xe}$
- (c) $\text{Li} > \text{Na} > \text{K} > \text{Rb} > \text{Cs}$
- (d) $\text{Be} < \text{Mg} < \text{Ca} < \text{Sr} < \text{Ba}$
- (e) $\text{Na} > \text{Mg} > \text{Al} > \text{Si} > \text{P}$

- (1) a, c and e (2) b, c and d
(3) a, b and c (4) b, d and e

35. From the statements given, identify the right choice that explains the reason for the change of a particular period property.

- (a) The effective nuclear force of attraction on the electrons of valence shell decreases, with increase in number of inner shells.
- (b) The successive ionization potential values of an element are in the order $I_1 > I_2 > I_3 > I_4$ -----
- (c) Due to decrease in atomic size, the electron affinity of an element increases along a period.
- (d) Electronegativity increases from top to bottom due to increase in atomic size.
- (e) Element with low ionization potential has high electropositivity.
- (f) Bonding in oxides become covalent to ionic from left to right in a period.

- (1) b, d and f (2) a, c and e
(3) a, b and e (4) b, c and f

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. Select the correct alternative from the statements that are not related to Mendeleev's periodic table.
 - (a) The physical and chemical properties of elements are the periodic function of their atomic numbers.
 - (b) The elements with higher atomic weight were placed before elements with lower atomic weights.
 - (c) The physical and chemical properties of elements are the periodic function of their atomic weights.
 - (d) Atomic number has been established as the fundamental characteristic of elements based on the work on x-ray spectra of elements.
 - (1) a and b (2) b and c
 - (3) c and d (4) a and d
2. Identify the types of elements which are good reducing agents.
 - (a) Alkali metals
 - (b) Halogen elements
 - (c) Noble gases
 - (d) Alkaline earth metals
 - (e) Chalcogens
 - (1) a and b (2) c and b
 - (3) d and a (4) d and e
3. Pick false statements from the following.
 - (a) The left side of the periodic table consists of the most electronegative elements and the right side of the table consist of the most electropositive elements.
 - (b) Paramagnetic nature, variable oxidation states, coloured compounds are exhibited by transition elements.
 - (c) Alkalis and alkaline earth metals react with water, liberating oxygen.
 - (d) Elements with more metallic character forms acidic oxides and with more non-metallic character forms basic oxides.
 - (e) Melting and boiling points of metals and non-metals increase and decrease respectively along a group.
- (f) Elements belonging to groups IA-VIIA are called representative elements.
 - (1) a, b, c and d (2) b, c, d and e
 - (3) a, c, d and e (4) b, d, e and f
4. Identify the correct statements from the following.
 - (a) An element with low ionization potential has high electropositivity and hence give out electrons easily.
 - (b) Due to decrease in ionization energy, in a group, the oxidizing property decreases.
 - (c) Electronegativity decreases along a period due to increase in nuclear charge and increase in atomic size.
 - (d) Due to increase in electron affinity the reducing property increases along a period.
 - (1) a and b (2) b and c
 - (3) a and c (4) c and d
5. Which of the following statements are not related to either Mendeleev's or Modern periodic tables?
 - (a) The position of hydrogen is not justified.
 - (b) Elements like Co and Ni were placed in the column where halogens were present.
 - (c) Classification of elements could hold good only up to atomic weight 40.
 - (d) Two sets of 14 elements were each placed outside the main body of the periodic table.
 - (1) b and c
 - (2) a and d
 - (3) b and d
 - (4) a and c
6. When a Dobereiner triad is considered, the sum of atomic weights of extreme elements X and Z is 177.6 and difference of Z and Y is five times the number of protons present in a neon atom. Identify X, Y and Z.
 - (1) $X \rightarrow \text{Ca}$, $Y \rightarrow \text{Sr}$, $Z \rightarrow \text{Ba}$
 - (2) $X \rightarrow \text{Li}$, $Y \rightarrow \text{Na}$, $Z \rightarrow \text{K}$
 - (3) $X \rightarrow \text{K}$, $Y \rightarrow \text{Rb}$, $Z \rightarrow \text{Cs}$
 - (4) $X \rightarrow \text{Sr}$, $Y \rightarrow \text{Ba}$, $Z \rightarrow \text{Ra}$
7. An element with atomic number '32' belongs to
 - (1) 4th period, VIA group or 16th group
 - (2) 3rd period, IVA group or 14th group
 - (3) 4th period, IVA group or 14th group
 - (4) 5th period, VA group or 15th group

8. Assuming that 113 elements are there in the periodic table now, what would be the group and period to which the newly added element belongs?
- IVA group, 7th period
 - VIA group, 7th period
 - VA group, 7th group
 - VIIA group, 6th period
9. An element is oxidized by fluorine but not by chlorine. Could the element be sodium or aluminium or sulphur or oxygen?
- Sodium
 - Sulphur
 - Oxygen
 - Aluminium
10. The electron affinities of which group of elements are positive? $M_{(g)} + e^- \rightarrow M_{(g)}^- \Delta H = +$ (Electron affinity)
- VIA
 - IVA
 - IA
 - IIA
11. The densities of transition metals are greater than the alkali and alkaline earth metals due to
- increase in effective nuclear charge in transition metals
 - increase in atomic size in transition metals
 - increase in number of valence electrons in transition metals
 - increase in number of shells
12. Successive ionization energies of an element X are 737.7 kJ/mole, 1450.7 kJ/mole, 10,500 kJ/mole respectively. What is the formula of the compound formed when it combines with a non-metal Y which has maximum number of unpaired electrons?
- XY_2
 - X_2Y_3
 - X_3Y_2
 - X_2Y
13. A tripositive ion of element 'X' has six electrons with $l = 0$ and five electrons with $l = 2$. Predict the group and period to which 'X' belongs.
- 17th group, 3rd period
 - 8th group, 5th period
 - 7th group, 5th period
 - 8th group, 4th period
14. Among the following metals which one has the least metallic character?
- Be
 - Mg
 - Ca
 - Sr
15. The total number of electrons present in first two and last two shells is the same for an atom of an element X. The sum of the electrons present in second, fourth and fifth shells is equal to the number of electrons present in third shell and fifth shell is valence shell. To which group in the periodic table would it belong?
- IVA (14)
 - IIA (2)
 - IIIA (13)
 - VIA (16)
16. Which group of elements in a periodic table can be used as strong reducing agents?
- VIIA
 - IVA
 - VIA
 - IA
17. Successive ionization potentials of an element 'X' are $I.P_1 = 520 \text{ kJmol}^{-1}$, $I.P_2 = 7,298 \text{ kJmol}^{-1}$ and $I.P_3 = 10,815 \text{ kJmol}^{-1}$. Predict the group to which X belongs.
- IA
 - IIA
 - IIIA
 - IVA
18. An element X belongs to IV period and 10th group in the periodic table. Give the valence shell electronic configuration of the element which is diagonal to the element X that belongs to 5th period.
- $[\text{Kr}] 4d^6 5s^2$
 - $[\text{Kr}] 4d^5 5s^2$
 - $[\text{Kr}] 4d^{10} 5s^1$
 - $[\text{Kr}] 4d^7 5s^2$
19. Identify the position of the elements having outer electronic configuration $ns^2 np^5$ for $n = 3$.
- 17th group, 3rd period
 - 8th group, 5th period
 - 7th group, 5th period
 - 8th group, 4th period
20. Which one of the following electronic configuration corresponds to the element with maximum electropositive character?
- $[\text{Kr}]5s^1$
 - $[\text{Ne}]3s^1$
 - $[\text{Ar}]4s^1$
 - $[\text{Xe}]6s^1$
21. The ascending order of the first ionization potential of C, N, O and F is ____.
- $C < F < O < N$
 - $O < C < N < F$
 - $C < O < N < F$
 - $C < N < O < F$

22. Which of the following elements acts as the best reducing agent?
 (1) Na (2) Cl
 (3) Mg (4) F
23. Elements E and F has atomic number 14 and 17 respectively. Find their position in the periodic table.
 (1) E \rightarrow 3rd period; 14th group F \rightarrow 3rd period, 17th group
 (2) E \rightarrow 4th period; 14th group F \rightarrow 4th period, 17th group
 (3) E \rightarrow 4th period; 17th group F \rightarrow 4th period, 14th group
 (4) E \rightarrow 3rd period; 17th group F \rightarrow 3rd period, 14th group
24. Element X has twelve neutrons in its nucleus. To which group in the periodic table would it belong?
 (1) 1
 (2) 2
 (3) 3
 (4) Cannot be predicted
25. The total number of elements present in 6th period are
 (1) 18 (2) 31
 (3) 32 (4) 17
26. Which of the following elements has maximum electro negativity?
 (1) P (2) S
 (3) Al (4) Si
27. Which of the following statements about the element Y whose atomic number is 19 is incorrect?
 (1) It belongs to group 1 of the periodic table.
 (2) It is metal.
 (3) Its chloride has the formula YCl.
 (4) It forms anions.
28. Which of the following elements doesn't belong to group IIA or 2nd group?
 (1) Be (2) Mg
 (3) Li (4) Ca
29. Which of the following is not a transition element?
 (1) Mn (2) Fe
 (3) Cu (4) K
30. Among the following elements, identify the best oxidizing agent.
 (1) P (2) S
 (3) Cl (4) Br
31. Among the elements belonging to the 4th period _____ has the maximum reducing power.
 (1) Ge (2) Ca
 (3) Br (4) K
32. Which of the following sequence of explanation is appropriate for explaining the reason for the periodicity of reducing property in a period or group?
 (a) Tendency to undergo oxidation decreases in a period and increases in a group.
 (b) In a period ionization energy increases and in a group it decreases.
 (c) In a period the atomic size decreases and in a group it increases.
 (d) The elements present in the left side of the periodic table have strong reducing property.
 (1) c b a d
 (2) c d b a
 (3) d c a b
 (4) d b a c
33. Which group elements have the highest ionization energy in the respective period?
 (1) 15th (2) 16th
 (3) 17th (4) 18th
34. Which group elements are the most reactive among the non-metals?
 (1) 15th (2) 16th
 (3) 17th (4) 18th
35. Match the entries given in column A with the appropriate ones in column B.
- | Column A | | Column B | |
|-----------------------------------|-----|---------------------------------------|--|
| A. Na ₂ O | () | a. Most acidic among the given oxides | |
| B. MgO | () | b. Amphoteric | |
| C. Al ₂ O ₃ | () | c. Most basic among the given oxides | |
| D. SiO ₂ | () | d. Basic | |
| E. Cl ₂ O ₇ | () | e. Most weakly acidic | |
- (1) A \rightarrow c, B \rightarrow d, C \rightarrow b, D \rightarrow e, E \rightarrow a
 (2) A \rightarrow d, B \rightarrow c, C \rightarrow b, D \rightarrow e, E \rightarrow a
 (3) A \rightarrow c, B \rightarrow d, C \rightarrow e, D \rightarrow b, E \rightarrow a
 (4) A \rightarrow e, B \rightarrow d, C \rightarrow b, D \rightarrow a, E \rightarrow c

ANSWER KEYS**PRACTICE EXERCISE 4 (A)**

1. 1	2. 2	3. 4	4. 4	5. 2	6. 1	7. 1	8. 4	9. 2	10. 4
11. 2	12. 3	13. 2	14. 2	15. 4	16. 4	17. 1	18. 4	19. 3	20. 4
21. 3	22. 4	23. 1	24. 1	25. 1	26. 1	27. 4	28. 1	29. 2	30. 4
31. 3	32. 4	33. 1	34. 3	35. 2					

PRACTICE EXERCISE 4 (B)

1. 4	2. 3	3. 3	4. 3	5. 1	6. 1	7. 3	8. 1	9. 3	10. 4
11. 1	12. 3	13. 4	14. 1	15. 2	16. 4	17. 1	18. 3	19. 1	20. 4
21. 3	22. 1	23. 1	24. 4	25. 3	26. 2	27. 4	28. 3	29. 4	30. 3
31. 4	32. 1	33. 4	34. 3	35. 1					

Chemical Bonding

SYNOPSIS

- **Reasons for the formation of a chemical bond:** Noble gases are the unique elements comprised of atoms having eight electrons (except helium) in their respective valence shells which is called the **octet configuration**. Helium has only two electrons in its first energy level. This is called **duplet configuration**.
- Except noble gases, atoms of all other elements in order to attain stability electrons are lost or gained or shared and a bond is said to be formed. This tendency of atoms to attain stable electronic configuration is known as **Octet rule or Law of octet**.
- The various types of chemical bonds are
 - (i) ionic bond (ii) covalent bond
 - (iii) dative bond (iv) metallic bond
- **Ionic bond or Electrovalent bond:** During the formation of an ionic bond, one atom loses electron(s) forming positively charged ion called **cation** while the other atom gains electron(s) forming negatively charged ion called **anion**. The cation and anion are held together by strong electrostatic forces of attraction. The electrostatic forces of attraction which holds the two oppositely charged ions together is called **ionic bond** or a chemical bond formed by complete transfer of one or more electrons from one atom to the other as a result of which the ions attain their nearest inert gas configuration is called **ionic bond**.

The resulting compounds formed are called **ionic compounds**.

- **Lewis dot formula:** To explain the various types of bonds and to visualise the shift in the valence electrons, G.N.Lewis proposed the Lewis dot formula. In this, the valence electrons of the participating atoms are shown in the form of dot or cross. The valence electron of one of the participating atoms is represented as dot and that of the other as cross.
- The number of electrons lost or gained by an atom of an element during the formation of an ionic bond is known as **electrovalency**. If we consider the formation of KCl, NaCl and MgCl_2 , electrovalencies of K, Na and Mg in these compounds are 1, 1 and 2 respectively and that of Cl is 1 in all the compounds.
- **Strength of ionic bond:** The magnitude of electrostatic force of attraction between the positively charged ions (cations) and negatively charged ions (anions) in an ionic compound is called **strength of ionic bond**.

The strength of ionic bond depends on the following two factors.

- (i) **Electronegativity of atoms:** Strength of ionic bond increases with increase in the difference between the electronegativity values of elements.
- (ii) **Atomic radii of the atoms:** Greater the difference in the atomic radii of the atoms, weaker is the strength of the ionic bond.

Example: $\text{NaCl} > \text{CsCl}$

- **Lattice energy:** The amount of energy released during the formation of one mole of ionic compound from its constituents which are brought from an infinite distance is known as **lattice energy**. The same amount of energy is required to break one mole of ionic compound into its constituent ions. The stability of ionic compound is explained in terms of lattice energy. Higher is the value of lattice energy, greater is the stability of an ionic compound. Lattice energy depends on the electronegativities and atomic radii of the constituents.
 - **Covalent bond:** Covalent bond was introduced by G.N.Lewis. Covalent bond is formed when two atoms share one or more electron pairs and attain their nearest inert gas configuration. Each atom contributes equal number of electron(s) towards the bond formation. Molecules whose atoms are bonded by covalent bonds are known as **covalent molecules**.
- The substances containing these molecules are called **covalent compounds**.
- A covalent bond formed by sharing of one electron pair between the atoms is called **single covalent bond**.
 - A covalent bond formed by sharing of two electron pairs between two atoms is called **double covalent bond**
 - A covalent bond formed by sharing of three electron pairs between two atoms is called **triple covalent bond**.
 - The electron pair which is shared between the bonded atoms is known as **bond pair**. The pair of electrons which are present in the valence shell of an element but not involved in the formation of a bond is called **lone pair**.
 - The number of electrons contributed by an atom for sharing during the formation of a covalent bond is called **covalency** of that element in the molecule.

○ **Factors responsible for the formation of ionic bond and covalent bond**

Factor	Ionic bond	Covalent bond
Ionization potential	The difference in ionization potential between the two atoms is more, ionic compounds are formed.	Atoms with higher ionization potential values are unable to lose their valence electrons and hence prefer to form covalent bonds by sharing of electrons.
Electron affinity	Atoms with very low electron affinity form ionic bond with the atoms of higher electron affinity.	The formation of a covalent bond is favoured when the combining atoms have almost equal electron affinity.
Electro negativity	Greater electronegativity difference between the two combining atoms leads to the formation of an ionic bond.	If the electronegativities of the combining atoms do not differ much, (<1.7) then the bond formed between them is likely to be covalent.
Metallic and non-metallic character	If one of the atoms is metallic and the other one is non-metallic, then the difference in ionization potential, electron affinity and electronegativity becomes more which leads to the formation of an ionic bond.	If both the atoms are non-metallic, then the difference in ionization potential, electron affinity and electronegativity is very less, this leads to the formation of a covalent bond.

○ **Types of covalent bond**

Nonpolar covalent bond (equal nuclei covalent bond) is a type of covalent bond formed between two atoms having no difference in their electronegativities. In most of the cases, it is formed between identical atoms. Hence the bonded atoms attract the shared pair of electrons to an equal extent which does not result in any charge separation within the molecule.

Polar covalent bond (unequal nuclei covalent bond or dipole bond) is a type of covalent bond

formed between two non-identical atoms. Since the two atoms differ in their capacity to attract the shared electron pair, unequal sharing of electrons results. Due to the unequal sharing of electrons, partial positive and negative charges which are known as **dipoles** are developed on the bonded atoms and the bond is said to be **polar**. Thus a slight ionic character is imparted to the bond due to the electronegativity difference between the two bonded atoms.

○ **Comparative study of the properties of ionic and covalent compounds**

Property	Ionic compounds	Covalent compounds	
		Polar	Nonpolar
Physical state	Most of the ionic compounds are crystalline solids.	Generally liquids or gases.	Generally liquids or gases.
Melting and boiling points	All the ionic compounds have high melting and boiling points.	Have low melting and boiling points.	Have low melting and boiling points.
Solubility	Ionic compounds are generally soluble in polar solvents like water, but insoluble in non-polar organic solvents.	Soluble in polar solvents and nonpolar solvents	Insoluble in polar solvents but soluble in nonpolar solvents
Density	Possess high density.	Possess low density.	Possess low density.
Electrical conductivity	Ionic compounds conduct electricity either in the fused state or in their aqueous solutions, due to the presence of mobile ions.	These compounds ionize in water and forms ions which help in electrical conductivity.	These compounds do not ionize and hence do not conduct electricity.

- **Exceptions to the octet rule:** The molecules may possess less than eight or more than eight electrons around the central atom. These are considered as deviations from octet rule.

- **Incomplete octet or Contracted octet:** Molecules in which the central atom possesses less than 8 electrons in its valence shell.

Examples: BF_3 , BeCl_2

- **Expanded octet:** Molecules in which the central atom possesses more than 8 electrons in its valence shell.

Examples: PCl_5 , SF_6 , IF_7

- **Concept of orbital overlapping:** According to this concept, covalent bond is formed when an overlapping takes place between the orbital of one atom with the orbital of another atom.

Conditions required for orbital overlapping:

- The orbitals belonging to the valence shell only take part in overlapping.
- Each of the overlapping orbitals should possess an unpaired electron.
- The electrons in the overlapping orbitals should have an opposite spin.

- **Different types of overlapping**

- s-s overlapping
- s-p overlapping
- p-p overlapping

- **Strength of a covalent bond:** The strength of a covalent bond depends on the extent to which the two combining atomic orbitals can overlap. The greater the extent of overlap between the atomic orbitals,

the greater is the strength of the resulting covalent bond.

The covalent bond formed by the end to end or head on or axial overlapping of atomic orbitals that are along the internuclear axis is called **sigma (σ) bond**. This type of overlapping results in a strong bond due to the greater extent of overlapping. The covalent bond formed by the sidewise or lateral overlapping of atomic orbitals that are perpendicular to the internuclear axis is called **pi (π) bond**. This type of overlapping results in a weak bond due to lesser extent of overlapping.

- **Hybridization** is a process of intermixing of two or more atomic orbitals of almost equal energies (belonging to the valence shell) of an atom and their redistribution into an equal number of identical orbitals. The resultant orbitals are called **hybrid orbitals**.
- Mixing up of one s-orbital and one p-orbital to give two new identical orbitals is called '**sp**' hybridization and the two orbitals formed are called '**sp**' hybrid orbitals.
- Mixing up of one s-orbital and two p-orbitals to form three new identical orbitals is called '**sp²**' hybridization and the three orbitals formed are called '**sp²**' hybrid orbitals.
- Mixing up of one s-orbital and three p-orbitals to form four new identical orbitals is called '**sp³**' hybridization and the four orbitals formed are called '**sp³**' hybrid orbitals.
- **Shapes of the covalent molecules:** On the basis of valence shell electron pair repulsion (VSEPR) theory,

the geometry and the shapes of the covalent molecules can be explained.

○ **Postulates of valence shell electron pair repulsion theory**

- (i) Different geometrical shapes of the covalent molecules are generated due to the repulsion between the electron pairs present in the valence shell of the central atom of the molecules.
- (ii) These electron pairs arrange themselves in such a way that the repulsion among them becomes minimum.
- (iii) The electron pairs involved in bond formation are called **bond pair of electrons**. The electron pairs which are present in the valence shell of central atom but not involved in bond formation are called **lone pair of electrons**.
- (iv) Repulsion between two lone pairs is greater than the repulsion between a lone pair and a bond pair which is in turn greater than the repulsion between two bond pairs. Therefore, the shape of the molecule does not depend only on the number of electron pairs, but also depends upon the number of bonded electron pairs and lone electron pairs on the central atom in that molecule.

○ **Coordinate covalent bond or dative bond:** Coordinate covalent bond is a special type of covalent bond in which the electron pair is provided by only one of the bonded atoms, but shared by both the bonded atoms.

○ The atom which donates the electron pair is called the **donor** and the other atom which accommodates the shared pair of electrons is called the **acceptor**. The coordinate bond is represented by a one sided arrow ' \rightarrow ' where the arrow head points towards the acceptor and the tail towards the donor. Coordinate covalent bond is also called **dative bond**.

○ Formation of coordinate covalent bond is considered as a combination of covalency (total number of covalent bonds) and electrovalency (number of electrons transferred during the formation of an ionic bond).

Example: Formation of hydronium ion $[H_3O^+]$

The lone pair of electrons is donated by O-atom of water and it is accepted by H^+ . Hence O-atom of water molecule is donor and H^+ is acceptor.

○ **Metallic bond:** Any metal is a crystalline substance. A metal atom generally has either 1, 2 or 3 electrons in its valence shell. It can easily lose these electrons and hence metals are highly electropositive in nature. These electrons lost by the metal are called **delocalised electrons** and the metal ions formed are called **kernel**s.

The force of attraction that exists between the delocalised electrons and the metal ions is known as **metallic bond**.

○ **Nonbonded or Intermolecular forces of attraction**

(i) **Vanderwaal's forces:** The weak forces which exist between the covalent molecules are known as **vanderwaal's forces**. There is an electrostatic force of attraction between the nucleus of one molecule and the electrons of the other. This is largely, but not completely neutralized by the electrostatic force of repulsion of electrons of one molecule by the electrons of the other or the nucleus of one molecule by the nucleus of the other. Thus resultant weak forces of attraction between the two molecules are called **vanderwaal's forces**.

(ii) **Dipole-dipole attractions:** In polar covalent molecules, the unequal sharing of bonded electron pair results in partial charge separation within the molecule. The molecule with opposite partial charges is called **dipole**. The opposite charges of adjacent dipoles align with each other and the forces of attraction existing between these oppositely charged ends of the adjacent dipoles are called **dipole-dipole attractions**. The dipole-dipole attractions are much stronger than vanderwaal's forces of attractions.

(iii) **Hydrogen bonding:** Polar covalent molecules which have a highly electronegative atom like F, O and N, bonded to a hydrogen atom become strongly polar. Some examples of such molecules are HF, H_2O , NH_3 . In such types of polar covalent molecules, the H-atom of one molecule gets attracted to the strongly electronegative atom of the other molecule due to the formation of the slight positive charge on the hydrogen atom and the slight negative charge on the more electronegative atom. This force of attraction that holds the hydrogen atom of one molecule to the highly electronegative atom of the other molecule is called **hydrogen bond**. It is represented by dotted lines (- - -)

○ **Redox reactions:** In a chemical reaction, if loss and gain of electrons takes place by the atoms or the ions, the phenomenon can be defined in terms of loss or gain of electrons.

○ **Oxidation:** During a chemical reaction, if an atom or an ion loses one or more electrons or undergoes

decrease in negative valency or increase in positive valency, then the atom or the ion is said to be oxidized and this process is called **oxidation**.

- **Reduction:** During a chemical reaction, if an atom or an ion gains one or more electrons or undergoes decrease in positive valency or increase in negative valency, then the atom or the ion is said to be reduced and this process is called **reduction**.
- **Redox reaction:** Loss and gain of electrons by atoms take place simultaneously in a chemical reaction and

hence the reaction involving simultaneous oxidation and reduction is called a redox reaction.

- **Oxidizing agent:** In the redox reaction, the atom or the ion that gains electron(s) is called an **oxidizing agent** or **oxidant**.
- **Reducing agent:** In the redox reaction, the atom or the ion that loses electron(s) is called a **reducing agent** or **reductant**.

Solved Examples

1. Between CaCl_2 and KCl , which has a stronger ionic bond? Why?

☞ **Solution:** Ca^{+2} ion is smaller than K^+ ion since the greater is the charge on cation, the greater is the effective nuclear charge and smaller is the size. Due to the smaller size of Ca^{+2} than K^+ , CaCl_2 has a stronger ionic bond than KCl .

2. Between sodium and magnesium which can form chlorides more easily and why?

☞ **Solution:** Sodium has lower IP value than magnesium. Therefore sodium has greater tendency to lose one electron and form Na^+ ion than magnesium which has to lose two electrons to form Mg^{+2} ion. As a result, sodium can form chlorides more easily than magnesium.

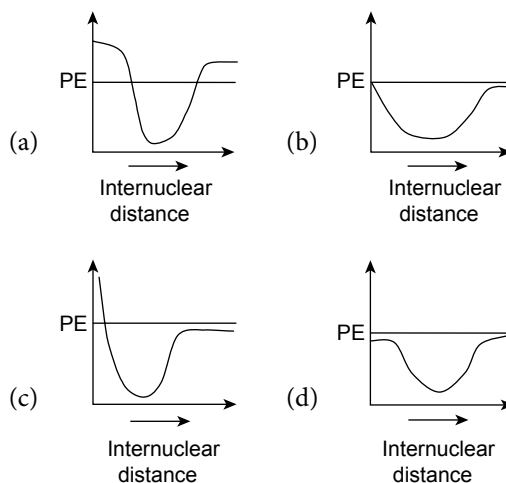
3. Graphite is a good conductor of electricity whereas diamond cannot conduct electricity. Explain.

☞ **Solution:** Carbon has a valency of 4. In graphite, each carbon atom's 3 electrons are strongly bonded to other carbon atoms forming a hexagonal structure while one of the electrons of graphite is loosely bound and can thus conduct electricity. In diamond, each carbon atom is attached to four other carbon atoms forming a tetrahedral structure and has no free or loosely bound electrons. Thus diamond cannot conduct electricity.

4. Is the electrovalency of metal and non-metal equal in a compound? Give few examples for ionic compounds in which metal and non-metal possess different electrovalencies.

☞ **Solution:** Electrovalency of metal and non-metal need not be same in an electrovalent compound. This is because of the fact that the number of electrons lost by a metal need not be equal to the number of electrons gained by a non-metal in a particular electrovalent compound. For example, in case of magnesium oxide, each magnesium loses two electrons and oxygen gains 2 electrons. Therefore the electrovalency of both metal and non-metal is 2. But, in case of calcium chloride, electrovalency of calcium is 2 and that of chlorine is 1.

5. In an IIT(F) class a teacher asked the students to sketch the potential energy diagram for the formation of hydrogen molecule. Four students A, B, C and D drew the following diagrams a, b, c and d among which three were considered wrong and one correct by the teacher. Guess the correct potential energy diagram and justify it.



☞ **Solution:** Diagram drawn by “C” is correct.

In the potential energy curve, when the distance between the atoms is large, the force of attraction between the atoms is less. Thus when the atoms move close to each other the energy released is less and hence the graph descends gradually. On coming closer, the force of attraction increases and descent in graph is steeper. On forming the chemical bond, i.e., when the energy is minimum, the force of attraction is equal to the force of repulsion. However, on moving the atoms even closer, the force of repulsions are very high due to the less distance and hence energy absorbed is also high and the graph increases in a steep fashion.

6. Compound ‘X’ conducts electricity in the aqueous solution or molten state. Compound ‘Y’ conducts electricity in the aqueous solution only. Compound ‘Z’ does not conduct electricity in the molten state or in aqueous solution. Predict the nature of bonds in X, Y and Z.

☞ **Solution:** Compound ‘X’ is ionic compound and the bond is ionic bond.

Compound ‘Y’ is polar covalent compound, and the bond is polar covalent bond.

Compound ‘Z’ is nonpolar covalent compound.

7. What type of bond formation takes place in liquor ammonia? Explain.

☞ **Solution:** In liquor ammonia (NH_4OH), three types of bond formation takes place.

- Ionic bond between NH_4^+ and OH^- .
- Coordinate bond between NH_3 and H^+
- Covalent bonds in NH_3 molecule and OH^- ion.

8. Why is water called an universal solvent?

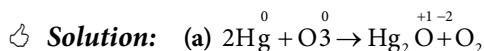
☞ **Solution:** Water (H_2O) is a polar covalent compound. Hence, it can dissolve many compounds such as polar covalent compounds. Due to the high charge separation, it can dissolve even ionic compounds. Owing to its ability to form hydrogen bonding also, it can dissolve number of polar covalent compounds. As such it dissolves many

types of substances in it and hence is called universal solvent.

9. Identify oxidizing and reducing agents in the following reactions.

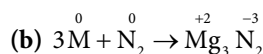
(a) Tailing of mercury.

(b) Burning of Mg in an inert atmosphere of nitrogen.



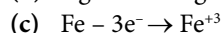
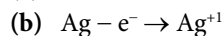
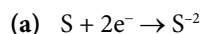
Hg act as reducing agent as Hg under goes oxidation.

O_3 act as oxidizing agent as O_3 undergoes reduction.

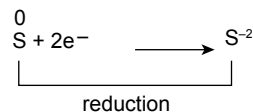


Mg act as reducing agent as Mg undergoes oxidation and N_2 act as oxidizing agent as N_2 undergoes reduction.

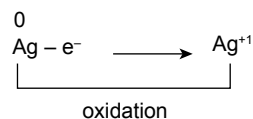
10. Identify the following reactions as either oxidation or reduction.



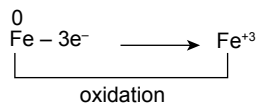
☞ **Solution:** (a) Gain of electrons or decrease in oxidation number is reduction.



(b) Loss of electrons or increase in oxidation number is oxidation.



(c) Loss of electrons or increase in oxidation number is oxidation.



PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

- In sodium sulphide, the corresponding cation and anion attain the stable electronic configurations of _____ and _____ respectively.
 - Ne and Ar
 - Ne and Kr
 - Ar and Ne
 - Kr and Ne
- Ionic compounds do not conduct electricity in solid state. Identify the correct reason.
 - Absence of oppositely charged ions in solid state
 - Absence of mobile ions in solid state
 - Absence of forces of attraction between ions in solid state
 - Absence of free electrons in solid state
- The pair of elements most likely to form an ionic compound are _____.
 - iodine and bromine
 - hydrogen and iodine
 - potassium and iodine
 - iron and carbon
- Compare NaCl and CsCl with respect to ease of formation and also the strength of the ionic bond.
 - Ease of formation of ionic bond is more in NaCl and strength of ionic bond is more in CsCl.
 - Ease of formation of ionic bond is more in CsCl and strength of ionic bond is more in NaCl.
 - Ease of formation of ionic bond is same in both CsCl and NaCl.
 - Strength of ionic bond is same in both CsCl and NaCl.
- A list of reactions are given below:
 - $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$
 - $\text{FeS} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2\text{S}$
 - $\text{Fe} + \text{S} \xrightarrow{\Delta} \text{FeS}$
 - $\text{NaCl} + \text{H}_2\text{SO}_4 \xrightarrow{< 200^\circ\text{C}} \text{NaHSO}_4 + \text{HCl}$
 - $\text{CuSO}_4 + \text{H}_2\text{S} \rightarrow \text{CuS} + \text{H}_2\text{SO}_4$
 - $\text{S} + \text{H}_2\text{SO}_4 \rightarrow 3\text{SO}_2 + \text{H}_2\text{O}$
 Identify redox reactions.
 - c and f
 - d and f
 - c and d
 - c, d and f
- Identify the linear molecule with lone pairs.
 - BeF_2
 - CO_2
 - C_2H_2
 - XeF_2
- Four elements A, B, C, D have 1, 2, 6, 7 valence electrons in their atoms. Assuming that they belong to the same period identify the strongest oxidizing agent among them.
 - A
 - B
 - C
 - D
- An element 'X' exhibits the maximum covalency of 7. Identify the ground state electronic configuration of 'X'?
 - $3s^2 3p^4$
 - $2s^2 2p^5$
 - $3s^2 3p^5$
 - Both 2 and 3
- Metals are lustrous in nature, having shiny appearance. Arrange the reasons given below in a sequence.
 - Emission of radiation or light energy by excited electrons makes a metal shiny in appearance.
 - The electrostatic forces of attraction between metal ions and the mobile electrons is called metallic bond.
 - The positive metal ions are surrounded by pool of electrons.
 - When light falls on the crystal, electrons get excited.
 - c b a d
 - c b d a
 - b c a d
 - b d c a
- "Though nitrogen and chlorine have almost equal electronegativity values, nitrogen forms hydrogen bonding while chlorine does not". This is due to
 - less size and more electronegativity of chlorine than nitrogen
 - more size and more electronegativity of chlorine than nitrogen
 - less size and more electronegativity of nitrogen than chlorine
 - more size and more electronegativity of nitrogen than chlorine
- H_2O is a liquid where as H_2S is a gas. This is due to
 - the molecular mass of H_2S is more than that of H_2O
 - the molecular mass of H_2S is less than that of H_2O

- (3) Presence of hydrogen bond in H_2S
 (4) absence of hydrogen bond in H_2S
12. In which of the following reactions, does a non-metal act as a reducing agent?
- (1) $\text{SiO}_2 + 2\text{C} \rightarrow \text{Si} + 2\text{CO}$
 - (2) $\text{AlN} + 3\text{H}_2\text{O} \rightarrow \text{Al}(\text{OH})_3 + \text{NH}_3$
 - (3) $2\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2$
 - (4) $\text{HgCl}_2 + 2\text{KI} \rightarrow \text{HgI}_2 + 2\text{KCl}$
13. Identify redox reaction among the following
- (1) Acid–base neutralization
 - (2) Precipitation reaction
 - (3) Metal displacement reaction
 - (4) All the above
14. Which among the following substances possess only vanderwaal's forces of attraction?
- (1) Argon
 - (2) Hydrogen fluoride
 - (3) Carbon disulphide
 - (4) Lead
15. Two elements M and X have electronic configurations 2, 8, 3 and 2, 8, 6 respectively. Identify the correct formula of the compound formed.
- (1) MX_2
 - (2) M_2X
 - (3) M_2X_3
 - (4) M_3X_2
16. Electrovalencies of three metals A, B, C are 1, 2, 3 respectively and those of non-metals X, Y, Z are 3, 2, 1 respectively. Which among the following couldn't be the formulae of the various ionic compounds formed between the respective metals and non-metals?
- (1) A_3X , BY , CZ_3
 - (2) AZ , B_3X_2 , C_2Y_3
 - (3) AZ_3 , B_2X , C_3Y_2
 - (4) A_2Y , BZ_2 , CX
17. Which among the following can form minimum number of hydrogen bonds?
- (1) Hydrogen fluoride
 - (2) Ammonia
 - (3) Water
 - (4) All the above
18. In CaF_2 , the number of electron(s) transferred from calcium to fluorine atoms are _____.
- (1) 1
 - (2) 2
 - (3) 3
 - (4) 4
19. MgCl_2 compound contains
- (1) MgCl_2 molecules.
 - (2) Mg atoms and Cl atoms.
 - (3) Mg^{2+} ions and Cl^- ions.
 - (4) Mg^+ ions and Cl^- ions.
20. Which of the following combinations of combining atoms of elements gives rise to the strongest ionic bond?
- (1) Sodium and iodine
 - (2) Sodium and chlorine
 - (3) Sodium and bromine
 - (4) Sodium and fluorine
21. Identify the favourable conditions for the formation of ionic bond.
- (1) Low IP value of metal, low EA value of non-metal.
 - (2) High IP value of metal, high EA value of non-metal.
 - (3) Low IP value of metal, high EA value of non-metal.
 - (4) High IP value of metal, low IP value of non-metal.
22. Which of the following is a common feature of all electrovalent compounds?
- (1) High melting point
 - (2) Conduction of electricity in solid state
 - (3) Presence of molecules
 - (4) Solubility in carbon tetrachloride
23. Among the alkali metals, the increasing order of ease of formation of cations is
- (1) $\text{Cs} < \text{Rb} < \text{K} < \text{Na} < \text{Li}$
 - (2) $\text{Li} > \text{Na} > \text{K} > \text{Rb} > \text{Cs}$
 - (3) $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$
 - (4) $\text{Cs} > \text{Rb} > \text{K} > \text{Na} > \text{Li}$
24. Two substances X and Y are dissolved in water under suitable conditions. X is a gas while Y is a solid under normal conditions. Solution of Y is found to conduct electricity but not 'X'. Based on the conclusion, identify the nature of bond present in X and Y with appropriate reasons as given below. Arrange the steps given below in a sequence.
- (a) Y is a solid at room temperature and its aqueous solution conducts electricity. This shows that it is an ionic compound.
 - (b) X on dissolution in water doesn't conduct electricity and is a gas at room temperature. Hence it should be a nonpolar covalent molecule.
 - (c) Aqueous solutions of both ionic compounds and polar covalent compounds conduct electricity because of the presence of free ions.
 - (d) All ionic compounds are solids and most of the nonpolar covalent molecules are gases or solids at room temperature. Polar covalent compounds are liquids or gases.
- (1) c d b a
 - (2) a d c b
 - (3) a c b d
 - (4) c a b d

25. Which of the following species cannot act as an electron pair donor for the formation of dative bond?
- (1) H_3O^+ (2) NH_4^+
(3) OH^- (4) NH_3
26. Identify the metal associated with the weakest metallic bond.
- (1) Sodium (2) Gold
(3) Mercury (4) Gallium
27. Which of the following represents the correct increasing order of forces of attraction between the molecules?
- (1) Oxygen, sodium chloride, mercury, water, hydrogen chloride
(2) Oxygen, hydrogen chloride, water, mercury, sodium chloride
(3) Oxygen, water, hydrogen chloride, mercury, sodium chloride
(4) Oxygen, mercury, water, hydrogen chloride, sodium chloride
28. Identify the correct descending order of strengths of bonds formed by the overlapping of the respective orbitals.
- (1) $s-s > s-p > p-p > \sigma > p-p > \pi$
(2) $p-p > \sigma > s-p > s-s > p-p > \pi$
(3) $s-p > s-s > p-p > \sigma > p-p > \pi$
(4) $s-s > p-p > \sigma > s-p > p-p > \pi$
29. Identify the ionic compounds in which electrovalency of metal is 3 and that of non-metal is 1.
- (A) AlF_3 (B) Al_2O_3
(C) FeCl_2 (D) FeCl_3
(E) Mg_3N_2
- (1) A, B & E (2) A, C & D
(3) A & D (4) A & E
30. An atom of an element has one unpaired electron in its valence shell. The quantum numbers of the electron could be $n = 3$ and $l = 1$. The probable maximum covalencies exhibited by the element could be
- (1) 5, 7 (2) Only 5
(3) 3, 5 (4) 3, 7
31. The number of hydrogen bonds formed by a molecule each of H_2O , HF and NH_3 respectively are
- (1) 2, 2, 3 (2) 4, 2, 3
(3) 2, 1, 3 (4) 4, 4, 3
32. Three molecules X, Y and Z have a contracted octet, an octet and an expanded octet. Identify them.
- (1) CH_4 , SF_6 , CCl_4 (2) CCl_4 , SCl_4 , BF_3
(3) BeCl_2 , CCl_4 , SF_6 (4) XeF_6 , CH_4 , IF_7
33. An ionic bond is a strong electrostatic force of attraction. Which of the following properties of ionic compounds is not related to the above characteristic?
- (1) Hard and brittle solids
(2) Electrical conductivity
(3) High density
(4) High melting point
34. Which of the following is inevitable in a chemical bond formation?
- (1) Increase in potential energy
(2) Octet formation
(3) Sigma bond formation
(4) Decrease in potential energy
35. Chlorine does not show hydrogen bonding in its compounds while nitrogen shows hydrogen bonding in its compounds. Identify the correct reason.
- (1) Chlorine is not as highly electronegative as nitrogen.
(2) Chlorine has vacant d-orbitals while nitrogen has no vacant 'd' sub shell.
(3) H - Cl bond is stronger than N - H bond.
(4) Chlorine has larger size than nitrogen.

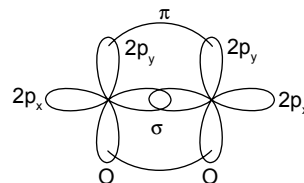
PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 40: For each of the questions, four choices have been provided. Select the correct alternative.

1. Among the following molecules, p - p overlap takes place in
- (1) H_2 (2) BeCl_2
(3) F_2 (4) HF

2. The element which can never attain octet configuration in any of its compounds is _____
- (1) K
(2) Li
(3) F
(4) O

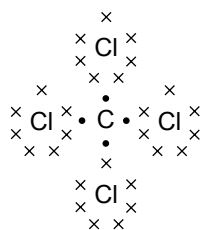
3. In the formation of AlF_3 , aluminium atom has to lose _____ electrons.
 (1) 1 (2) 2
 (3) 3 (4) 4
4. During the formation of CaO , oxygen and calcium attain stable configurations of _____ and _____ respectively.
 (1) Ne, Kr (2) Ar, Kr
 (3) Kr, Ar (4) Ne, Ar
5. The total number of electrons involved in the formation of CH_4 molecule are
 (1) 6 (2) 2
 (3) 4 (4) 8
6. In which of the following molecules partial charge separation does not take place?
 (1) Chlorine (2) Hydrochloric acid
 (3) Water (4) Ammonia
7. Which among the following molecules is not affected when placed between charged parallel plates?
 (1) Water (2) Ammonia
 (3) Hydrochloric acid (4) Bromine
8. Which of the following is a true statement?
 (1) In polar compounds shared pair of electrons is away from the more electronegative atom.
 (2) Polar compounds are good conductors of electricity in their vapour state.
 (3) In polar compounds separation of charges take place.
 (4) Polar compounds are good conductors of electricity in solid state.
9. Which one of the following molecules is covalent?
 (1) Sodium oxide (2) Calcium oxide
 (3) Calcium fluoride (4) Methane
10. The atomic numbers of 4 elements W, X, Y and Z are 8, 9, 11 and 16 respectively. Covalent bond is formed between
 (1) W and Y (2) Y and Z
 (3) X and Y (4) W and Z
11. The total number of chemical bonds present in hydronium ion is _____.
 (1) 1 (2) 2
 (3) 3 (4) 4
12. Hydrogen bond formation takes place between hydrogen atom and an atom having high _____.
 (1) electronegativity (2) electronegativity
 (3) ionization potential (4) atomic size
13. Which of the following does not conduct electricity in its molten state?
 (1) Iron (2) Magnesium oxide
 (3) Lithium fluoride (4) Sulphur
14. Strongest hydrogen bond is present in _____.
 (1) HF (2) H_2O
 (3) H_2S (4) PH_3
15. Two atoms of elements X and Y contribute an electron each during the bond formation and both X and Y have equal tendency to attract the shared electron pair. The type of bond formed between X and Y is _____.
 (1) polar covalent bond
 (2) ionic bond
 (3) coordinate covalent bond
 (4) non-polar covalent bond.
16. Which properties of substances are attributed to hydrogen bonding?
 (1) Solubility of some covalent substances in water.
 (2) Existence of certain substances such as water or alcohol in liquid state.
 (3) Higher boiling points of some substances in comparison with the analogous binary compounds of the other elements belonging to same groups.
 (4) All of the above
17. An element 'X' has 5 electrons in its valence shell which is 'L' shell. It forms a binary compound with hydrogen. In its liquid state, intermolecular forces exist between the molecules. Name the type of forces.
 (1) Hydrogen bond
 (2) Metallic bond
 (3) Electrostatic force
 (4) Dipole-dipole attractions only
18. The formation of double bond in an oxygen molecule is explained below. Arrange the given points in a sequential order.



- (a) $2p_y$ orbitals of each oxygen atom overlap laterally/sidewise to form a pi bond.
- (b) Thus, double bond between two oxygen atoms in which one $p_z - p_z$ sigma bond and $p_y - p_y$ pi bond is formed.
- (c) All the three $2p$ orbitals are perpendicular to each other. Hence $2p_z$ orbitals of each oxygen atom overlap end to end to form a sigma bond.
- (d) The electronic configuration of oxygen is O: $1s^2 2s^2 2p_x^1 2p_y^2 2p_z^1$.
- (1) c a d b (2) d c a b
(3) c d b a (4) c d a b

19. The necessary steps required to show the formation of CCl_4 by Lewis electron dot diagram have been jumbled. Arrange them in a sequence.

- (a) Thus, an electron pair is shared between C and Cl. This is the Lewis electron dot diagram for CCl_4 .



- (b) Write the symbol of chlorine and represent its valence electrons with the help of crosses, that is,



- (c) Write the symbol of carbon and represent its valence electrons with the help of dots, that is,



- (d) When carbon combines with four chlorine atoms, the carbon atom contributes four electrons for sharing whereas each chlorine atom contributes only one electron for sharing. Thus, both the atoms in CCl_4 attain an octet.

- (1) a c b d (2) b a c d
(3) d c b a (4) c b d a

20. What type of bond formation takes place between the atoms of group IA and group VIIA?

- (1) Polar covalent bond
(2) Nonpolar covalent bond
(3) metallic bond
(4) Ionic bond

21. Identify false statement regarding sigma and pi bonds

- (1) In sigma bond electron cloud is distributed in a cylindrically symmetrical way around the axis.
(2) In pi bond electron cloud is distributed in above and below the axis.
(3) strength of sigma bond is greater than pi bond
(4) s-orbitals can form pi bond

22. How many valence electrons of each oxygen are involved in the formation of a molecule of oxygen?

- (1) 1 (2) 2
(3) 3 (4) 4

23. How many lone pair of electrons are present on the central atoms of CH_4 , NH_3 , PCl_3 and PCl_5 molecules?

- (1) 0, 1, 1, 0 (2) 0, 1, 1, 1
(3) 0, 0, 1, 1 (4) 0, 0, 0, 1

24. A molecule has 3 bond pairs and 1 lone pairs on the central atom. Identify the molecule.

- (1) ClF_3 (2) SF_6
(3) CH_4 (4) PCl_3

25. Predict hybridization and shape of SF_4 molecule.

- (1) sp^3d and see saw
(2) sp^3 and tetrahedral
(3) sp and t-shape
(4) sp^3d^2 and octahedral

26. The covalency of nitrogen in ammonium ion is _____.

- (1) 1 (2) 2
(3) 3 (4) 4

27. _____ is present among the molecules of HCl.

- (1) Electrostatic force
(2) Hydrogen bond
(3) Dipole-dipole attraction
(4) All of the above

28. Among the following molecules H-bond is present in

- (1) NH_3 (2) PH_3
(3) H_2S (4) CH_4

29. The force of attraction that holds the hydrogen atom of one molecule to the strongly electronegative atom of adjacent molecule is called

- (1) electrostatic force of attraction
(2) vanderwaal's forces
(3) hydrogen bonding
(4) None of these

30. The covalency of oxygen in hydronium ion is equal to number of

- (1) covalent bonds.
- (2) coordinate bonds.
- (3) covalent bonds and coordinate bonds.
- (4) valence electrons.

31. Identify the correct combination from the following.

Column I	Column II
A Hydrogen	Hydrogen bonding
B Hydrogen iodide	Dipole – dipole forces
C Ammonia	Hydrogen bonding
D Mercury	Vanderwaals forces
E Magnesium oxide	Dipole – dipole forces

- (1) B & C
- (2) A, B & C
- (3) A & D
- (4) A, D & E

32. Identify the correct set of electrovalent compounds from the following in which the metal has electrovalency 2 and non-metal has electrovalency 3.

- (A) Calcium sulphide
- (B) Barium nitride

(C) Magnesium phosphide

(D) Aluminium nitride

(E) Magnesium fluoride

- (1) B & C
- (2) B & D
- (3) C & D
- (4) A, B, C & E

33. The maximum covalency exhibited by an element is 6. The number of unpaired electrons in the ground state of an atom is

- (1) 1
- (2) 2
- (3) 3
- (4) 4

34. The nature of bonds present in sodium hydroxide are

- (1) ionic, covalent and coordinate covalent.
- (2) ionic and covalent.
- (3) covalent and coordinate covalent.
- (4) ionic and coordinate covalent.

35. Identify the sets of molecules which possess the same hybridization as that of a methane molecule.

(A) Ammonia

(B) Ethene

(C) XeF_4

(D) Water

(1) A, B

(2) B, C

(3) A, B, D

(4) A, D

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 2 | 5. 1 | 6. 4 | 7. 4 | 8. 3 | 9. 2 | 10. 3 |
| 11. 4 | 12. 1 | 13. 3 | 14. 1 | 15. 3 | 16. 3 | 17. 1 | 18. 2 | 19. 3 | 20. 4 |
| 21. 3 | 22. 1 | 23. 3 | 24. 1 | 25. 2 | 26. 3 | 27. 2 | 28. 1 | 29. 3 | 30. 4 |
| 31. 2 | 32. 3 | 33. 2 | 34. 4 | 35. 4 | | | | | |

PRACTICE EXERCISE 5 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 4 | 5. 4 | 6. 1 | 7. 4 | 8. 3 | 9. 4 | 10. 4 |
| 11. 3 | 12. 2 | 13. 4 | 14. 1 | 15. 4 | 16. 4 | 17. 1 | 18. 2 | 19. 4 | 20. 4 |
| 21. 4 | 22. 2 | 23. 1 | 24. 4 | 25. 1 | 26. 4 | 27. 3 | 28. 1 | 29. 3 | 30. 3 |
| 31. 1 | 32. 1 | 33. 2 | 34. 2 | 35. 4 | | | | | |

Chemical Kinetics and Chemical Equilibrium, Electrochemistry

SYNOPSIS

- Based on the time taken for the completion of a reaction, the chemical reactions are classified into four categories.

(i) **Instantaneous reactions:** The reactions which reach completion within a fraction of a second are called **instantaneous reactions**.

Examples: Burning of some active metals, acid base neutralization reactions involving strong acids and bases etc.

(ii) **Slow reactions:** The chemical reactions which require few hours for completion are called **slow reactions**.

Examples: Esterification, thermal decomposition of potassium chlorate etc.

(iii) **Very slow reactions:** Some chemical reactions which require long time ranging from days to months or even years for completion. These reactions are called **very slow reactions**.

Examples: Decomposition of organic matter, formation of coal and petroleum, rusting of iron fermentation of glucose etc.

(iv) **Moderate reactions:** The chemical reactions which are neither fast nor slow and require few

minutes for completion are called **moderate reactions**.

Example: Reaction between zinc and hydrochloric acid, combination of hydrogen and iodine etc.

- **Rate (velocity) of a chemical reaction:** The change in concentration of the reactants or products with respect to time is known as the rate of a reaction or velocity of a reaction.

Rate of reaction =

$$\frac{\text{Change in concentration of reactants or products}}{\text{Time interval}}$$

$\Delta C \rightarrow$ change in concentration of reactants or products,

$\Delta t \rightarrow$ time interval and $r \rightarrow$ rate of reaction

$$\therefore r = \frac{\Delta C}{\Delta t}$$

If the rate of reaction is measured with respect to reactants, it is given a negative sign which indicates the decrease in concentration of reactants with time.

$$r = \frac{-\Delta C_{\text{Reactants}}}{\Delta t}$$

- If the rate of reaction is measured with respect to products, it is given a positive sign which indicates the increase in concentration of products with time.

$$r = \frac{+\Delta C_{\text{Products}}}{\Delta t}$$

- **Units of rate of reaction:** Since the concentration is expressed in moles/ ℓ and time is expressed in seconds, the rate of reaction is expressed in mole $\ell^{-1} \text{ sec}^{-1}$.
- **Average reaction rate Vs Instantaneous reaction rate:** The rate of reaction at the beginning of the reaction is proportional to the initial concentrations of the reactants. This is called the **initial rate of reaction**. The rate of a reaction determined at a particular instant is called the **instantaneous reaction rate**. The rate of reaction continuously changes during the course of reaction. Hence the average rate of reaction is the change in the concentration of reactants or products in a definite interval of time.
- For general reaction, $aA + bB \rightarrow cC + dD$

$$r = -\frac{1}{a} \frac{\Delta C_A}{\Delta t}, \quad r = -\frac{1}{b} \frac{\Delta C_B}{\Delta t},$$

$$r = +\frac{1}{c} \frac{\Delta C_C}{\Delta t}, \quad r = +\frac{1}{d} \frac{\Delta C_D}{\Delta t}$$

$$\therefore r = -\frac{1}{a} \frac{\Delta C_A}{\Delta t} = -\frac{1}{b} \frac{\Delta C_B}{\Delta t} = \frac{1}{c} \frac{\Delta C_C}{\Delta t} = +\frac{1}{d} \frac{\Delta C_D}{\Delta t}$$

where ΔC_A , ΔC_B , ΔC_C , and ΔC_D are small changes in the concentrations of A, B, C and D respectively that occur in small interval of time Δt .

- **Factors influencing the rate of a reaction:** Every chemical reaction has its own characteristic rate. Nevertheless, it is affected by some factors. The most important factors are
 - concentration of reactants
 - temperature and
 - catalyst
- The reason behind different rates for different chemical reactions and factors influencing the rate of a reaction have been interpreted in terms of **collision theory of gases**. The basic concept behind this collision theory lies in **kinetic molecular theory of gases**.
- **Postulates of collision theory of reaction rates**
 - A chemical reaction takes place due to collisions between the reactant molecules.
 - The rate of reaction does not correspond to the number of collisions taking place in the reaction. That means, all the collisions do not lead to the formation of products.

- The collisions which finally lead to the transformation of reactants into products are called **effective collisions** or **fruitful collisions**. The rest of the collisions are called **ineffective collisions** as they do not lead to the formation of products.
- For the effective collisions, the colliding molecules should be associated with certain minimum amount of energy called **threshold energy**.
- The reactant molecules which are associated with different energies must gain some energy and reach threshold energy. This energy which the reactant molecules have to acquire in order to lead to the effective collisions is called **activation energy**.
- Apart from this, it is also necessary that the colliding molecules are to be oriented in proper direction. The direction at which molecules collide decides whether a collision leads to a chemical reaction or not.
- The molecules which cross the energy barrier and reach threshold energy with proper orientation form an activated complex. This activated complex which is at a high energy state loses energy and forms products.
- The reactions which are associated with low activation energy are fast and the reactions which are associated with high activation energy are slow.

- **Effect of concentration:** With the increase in the concentration of the reactants, the number of reactant molecules per unit volume increases. As a result, the number of collisions increases which results in the net increase of effective collisions. Therefore, the rate of a reaction increases.
- **Rate law** is an expression which gives a quantitative estimation of the change in rate of reaction with the change in concentration of reactants. The establishment of quantitative relationship between the rate of reaction and concentration of the reactants cannot be obtained from the balanced chemical equation. This is because all the reactants participating in the reaction need not necessarily affect the rate of chemical reaction to the same extent. It can be done only by experimental methods.
- For the general reaction, $aA + bB \rightarrow \text{Products}$
 - A reaction can take place in one step or several steps. For a reaction which takes place in several steps, the rate of the reaction depends upon the slowest step.

- (ii) The slowest step of the reaction is called the **rate determining step**. The overall rate of reaction is determined by the rate of the slowest step of the reaction.
- (iii) Hence, the rate law for the slowest step of the reaction, $r = k[A]^x [B]^y$, where $[A]$, $[B]$ are molar concentrations of A and B respectively and **k** is the **rate constant or specific reaction rate**.

The power 'x' is called order of the reaction with reference to 'A' and the power 'y' is called the order of the reaction with reference to 'B'. The sum of the powers (x + y) is called overall **order** of the reaction. It may or may not be equal to (a + b). Hence, **order of a reaction** can be defined as the sum of the powers to which the concentration terms are raised in the rate expression for that reaction.

- **Effect of temperature:** For most of the chemical reactions, the rate of reaction increases with increase in number of effective collisions. When the temperature increases, the kinetic energy of molecules increases. More number of molecules attain threshold energy, thereby increasing the number of fruitful collisions and hence the rate of reaction. In case of most of the chemical reactions, the rate of reaction increases by 2 or 3 times for increase in temperature by 10°C.
- **Effect of catalyst:** The chemical reactions can be carried out at a faster rate by increasing the temperature, but this is not possible in case of all reactions. More over, the reactions can be carried out at a lower temperature by using a catalyst. Since the process takes place at a lower temperature, the cost of production gets reduced. A catalyst generally increases the rate of reaction by providing an alternative path for the reaction. This alternative path is associated with lower activation energy when compared to the uncatalysed reaction, which is evident from the graph.

In most of the reactions, catalysts increase the rate of reactions. These are called **positive catalysts**.

There are few reactions in which catalysts can slow down the reactions. These are called **negative catalysts**.

Example: Decomposition of hydrogen peroxide can be slowed down if some substances like glycerine, urea, acetanilide, sodium pyrophosphate etc. are added to H_2O_2 .

- **Chemical equilibrium:** When any liquid is taken in a closed container, the surface molecules go into vapour state due to evaporation. At the same time, at some stage, the vapour molecules condense and go back to liquid state. Therefore, the level of liquid in the container remains constant when the rate of evaporation

and the rate of condensation become equal. This state is called **equilibrium**.

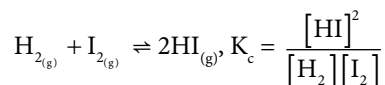
- The state of equilibrium is also attained in case of chemical reactions which can take place in either directions. Such reactions in which the reaction takes place in both the directions are called reversible reactions. Due to the attainment of equilibrium state, these reactions do not reach completion.
- **Reversible reactions:** Reactions in which the reactants are converted to products and the products are converted back to reactants are called **reversible reactions**. The reaction in which the reactants are converted to products is called **forward reaction**. The reaction in which the products are converted back to reactants is called **backward reaction**.
- **Irreversible reactions:** Reactions in which the reactants are converted to products but the products cannot be converted back to reactants are called **irreversible reactions**. These reactions take place only in one direction.
- **Characteristics of dynamic equilibrium**
 - (i) The observable properties such as concentration, density, colour, pressure, etc., remain constant at constant temperature.
 - (ii) Equilibrium can be attained from either direction.
 - (iii) Usage of a catalyst does not alter the position of equilibrium but it makes to attain equilibrium earlier.
 - (iv) Equilibrium state proceeds indefinitely unless it is disturbed by external factors.
- **Law of chemical equilibrium or Law of mass action:** **Gulberg** and **Wage** proposed a law in order to establish a quantitative relationship between the concentrations of the reactants and products at equilibrium. For a reversible reaction $xA + yB \rightleftharpoons mC + nD$
 $r_f \propto [A]^x [B]^y$, where r_f is the rate of forward reaction
 $r_f = k_f [A]^x [B]^y$; where k_f is the rate constant for forward reaction.
 $r_b \propto [C]^m [D]^n$, where r_b is rate of backward reaction
 $r_b = k_b [C]^m [D]^n$; where k_b is the rate constant for backward reaction.
 At equilibrium, $r_f = r_b$
 $\therefore K_f [A]^x [B]^y = K_b [C]^m [D]^n$
 $\frac{k_f}{k_b} = K_c = \frac{[C]^m [D]^n}{[A]^x [B]^y}$, where **K_c** is called **equilibrium constant**.
- **Equilibrium constant** can be defined as the ratio of the product of molar concentrations of products to the

product of the molar concentrations of reactants with all of them raised to the powers of their coefficients in the balanced chemical equation.

- **Application of law of mass action to various equilibria:** The chemical equilibria basically are of two types.

- (i) **Homogeneous equilibria:** In these equilibrium reactions, all the reactants and products are in one phase only. In these cases, when all the reactants and products are in gaseous phase, the molar concentrations of all the substances are taken into consideration for writing the equilibrium constant.

Example:



- (ii) **Heterogeneous equilibria:** In the reactions involving heterogeneous equilibria, the reactants and the products exist in different phases. In these cases, all the reactants and products are not taken into consideration for writing the equilibrium constant. The concentrations of the reactants and the products existing in solid state or in pure liquid state are taken as unity since their concentrations do not undergo any change during the chemical reaction.

Example: $\text{NH}_4\text{HS}_{(s)} \rightleftharpoons \text{NH}_{3(g)} + \text{H}_2\text{S}_{(g)}$

$$K_c = \frac{[\text{NH}_3][\text{H}_2\text{S}]}{[\text{NH}_4\text{HS}]}$$

Since $[\text{NH}_4\text{HS}]_{(s)} = 1$; $K_c = [\text{NH}_3][\text{H}_2\text{S}]$

- **Equilibrium constant in terms of partial pressure:** The expression for equilibrium constant involves molar concentration of reactants and products and hence is called equilibrium constant with respect to concentration (K_c). However, in case of gas phase reactions, the concentrations of reactants and products can be expressed preferably in terms of partial pressures of the gases in the expression. Therefore it is called equilibrium constant with respect to pressure and is denoted by K_p .
- **Applications of equilibrium constant**
 - (i) On the basis of the value of the equilibrium constant, it is possible to predict the direction of a chemical reaction. The ratio of molar concentrations of the products to the reactants at any stage of the reaction is known as the **reaction quotient** (Q_c). Depending on the relative values of K_c and Q_c , it is possible to predict the direction of the equilibrium reaction.

If $Q_c = K_c$, the reaction is at equilibrium. If $Q_c > K_c$, the reaction proceeds in the backward direction. If $Q_c < K_c$, the reaction proceeds in the forward direction.

- (ii) A greater value of K_c implies that the reaction mostly proceeds towards the products and the yield of the products will be more. A lower value of K_c indicates the lesser yield of products.
- (iii) K_c values help in the calculation of the equilibrium concentrations of various substances in the reaction.

- **Factors affecting chemical equilibrium**

The different factors which affect the chemical equilibrium are, the concentration of the reactants or products, temperature and pressure. The change in the behaviour of the system at equilibrium due to the alteration of those factors was first enunciated by **Le Chatelier**.

- **Le Chatelier's principle:** According to this principle, when a system at equilibrium is subjected to a constraint or change, the position of the equilibrium shifts in a direction that opposes the constraints.

- (i) **Effect of concentration:** When the concentration of any of the reactants or products in a reaction at equilibrium is changed, the composition of the equilibrium reaction mixture also changes in such a way as to compensate the effect of the concentration change. Addition of reactant(s) or removal of product(s) favours forward reaction. Addition of product(s) or removal of reactant(s) favours backward reaction.

- (ii) **Effect of pressure:** When a system at equilibrium is subjected to increase in pressure, the reaction takes place in that direction which is associated with less number of moles and vice versa.

- (iii) **Effect of temperature:** For all endothermic reactions, high temperature is the favourable condition for greater yield of products.

For all exothermic reactions, low temperature is the favourable condition for greater yield of products.

Electrochemistry

- Electrochemical reactions are basically of two types. First, the oxidation-reduction reactions which take place with the passage of electricity and is known as **electrolysis** and second, the oxidation-reduction reactions which result in the generation of electricity.

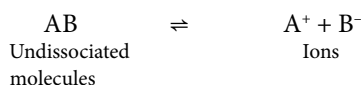
- The materials in which conduction takes place due to the flow of free electrons are called **electronic conductors**. Example: Metals, graphite. Since all metals come under this category, these are also called **metallic conductors**. Some compounds conduct electricity because of the movement of ions in their molten state or in aqueous solution. This type of conductors are called **electrolytic conductors** or **electrolytes**. Example: HCl, NaOH, KCl. The substances which do not contain ions and hence do not conduct electricity either in molten state or in solution state are called **nonelectrolytes**.

Example: Glucose, sugar etc.

- Mostly, all the electrovalent compounds in their fused or molten state conduct electricity. The electrical conduction in these can be attributed to the presence of mobile ions.
- Not only ionic compounds, polar covalent compounds also conduct electricity in solution state. Due to the polarity within the molecules of polar covalent compounds, charge separation takes place in solution state. The process of formation of oppositely charged ions from the molecules of polar covalent compound is called **ionization**.

Example: $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$

- In order to explain the process of electrolysis, Arrhenius in 1887 proposed a theory known as **theory of electrolytic dissociation** largely confined to aqueous solutions of the electrolytes.
- **Postulates of Arrhenius theory of electrolytic dissociation**
 - (i) The molecules of the electrolyte when dissolved in water, dissociate into two kinds of charged particles – positively charged particles or ions and negatively charged particles or ions. This process is known as **ionization or electrolytic dissociation**.
 - (ii) When a voltage is applied, cations move towards the cathode and anions move towards the anode.
 - (iii) The number of positively charged ions and negatively charged ions may be different, but the total positive and total negative charges carried by cations and anions respectively are same. Hence the electrolytic solution at any instant remains electrically neutral.
 - (iv) There is an equilibrium between the ions and undissociated molecules of the electrolyte.



- (v) The fraction of the total number of molecules which are present as ions in the solution is called **degree of dissociation** of the electrolyte.

- On the basis of degree of dissociation, electrolytes can be classified into two types. They are strong electrolytes and weak electrolytes.

Strong electrolyte	Weak electrolyte
These electrolytes are highly ionized in the solution and have high degree of ionization.	These electrolytes are feebly ionized and have low degree of ionization.

- **Process of electrolysis:** The process of electrolysis is carried out in an electrochemical cell called **electrolytic cell or voltameter**.
- The electrolytic cell consists of a glass vessel in which electrolyte is taken in molten state or in aqueous solution state. Two conductors (metal plates or graphite rods) are dipped in the electrolyte and are known as **electrodes**. The electrode which is connected to the positive terminal of the battery (that is the source of electricity) is called **anode** and the one which is connected to the negative terminal of the battery is called **cathode**.
- When an electric current is passed through an electrolyte, cations move towards the cathode and anions move towards the anode. Cations accept the electrons from the cathode and get neutralised whereas anions give up their negative charge by releasing electrons at the anode and become neutral. Hence oxidation takes place at the anode and reduction takes place at the cathode. The number of electrons gained by the anode is equal to the number of electrons lost at the cathode.
- Generally metals and hydrogen are deposited and liberated at the cathode respectively and non-metals are liberated at the anode.

- **Faraday's laws of electrolysis**

I Law: The amount of substance deposited or liberated or dissolved at an electrode is directly proportional to the quantity of electricity passed through the electrolyte.

Mathematical representation

$m \propto Q$ (m = mass of substance deposited or liberated or dissolved at the electrode)

(Q = quantity of electricity passed through the electrolyte)

$Q = c \times t$ (c = current strength in amperes; t = time of flow of current in seconds)

$\therefore m \propto ct$ or $m = ect$ (e = constant called electrochemical equivalent)

If $c = 1$ amp; $t = 1$ sec (or $Q = 1$ coulomb) then $m = e$

- Therefore, **electrochemical equivalent** can be defined as the mass of substance which undergoes electrode reaction at an electrode by the passage of one coulomb of electricity through the electrolyte.
- The amount of substance which undergoes electrode reaction by the passage of one faraday (96500 coulombs) of electricity is equal to the **equivalent mass** of the substance.

$$\text{Equivalent mass of an element} = \frac{\text{Atomic mass}}{\text{Valency}}$$

$$\text{Equivalent mass of a radical} = \frac{\text{Formula mass of the radical}}{\text{Valency}}$$

- Therefore the number of equivalents of substance deposited or liberated or dissolved at an electrode is equal to the number of faradays of electricity passed through the electrolyte.
- **Relation between equivalent mass and electrochemical equivalent**

$$\begin{aligned} \text{Electrochemical equivalent} &= \frac{\text{Equivalent mass}}{96500} \\ &= \frac{\text{Atomic mass}}{z \times 96500}, z = \text{valency of the element} \end{aligned}$$

$\therefore m = etc$

$$\therefore m = \frac{\text{Atomic mass} \times \text{current} \times \text{time}}{\text{Valency} \times 96500}$$

- **II Law:** For the passage of same quantity of electricity through different electrolytes, the amounts of respective substances deposited at the electrodes is in the ratio of the equivalent masses of the substances. If m_1 , m_2 and m_3 are masses of different substances and E_1 , E_2 and E_3 are the equivalent masses of the substances, $m_1 : m_2 : m_3 = E_1 : E_2 : E_3$ (when quantity of electricity is constant)
- **Galvanic Cells:** Based on the concept of electrolysis, it is obvious that chemical reactions can be carried out by making use of electrical energy. Similarly, it is possible to generate electrical energy by means of spontaneous redox reactions. The electrochemical cells used

for this purpose of conversion of chemical energy into electrical energy are known as **galvanic cells or voltaic cells or electrochemical cells**.

- A galvanic or voltaic cell or electrochemical cell consists of two half cells viz., anodic half cell where oxidation takes place and cathodic half cell where reduction takes place.
- **Single electrode potential:** Since the metal rod and the solution surrounding it differ in charge, a potential is developed between the metal rod and the salt solution. This potential developed at the interface of metal rod and the solution of its own ions is called **single electrode potential**. It is denoted by E .
- Hydrogen electrode has been taken as standard whose potential has been arbitrarily fixed as zero volts. This is known as **standard hydrogen electrode (SHE)**.

When the electrode system that is metal rod in contact with its salt solution is connected to SHE, depending on the nature of the metal, either oxidation or reduction may take place at the metal electrode. Each electrode system is called a **half cell**. If oxidation takes place in the half cell, it is called **oxidation half cell** and the potential developed is called **oxidation potential**. If reduction takes place in the half cell, it is called **reduction half cell** and the potential developed is called **reduction potential**. The electrode at which oxidation takes place is called **anode** and the electrode at which reduction takes place is called **cathode**.

- **Standard hydrogen electrode (SHE):** Hydrogen gas at 1 atm pressure is taken in contact with platinum surface and HCl solution of 1 molar concentration at 25°C temperature. This is called **standard hydrogen electrode**. The electrode potential has been assigned a value of zero volts.
- **Standard electrode potential:** Electrode potential depends upon the nature of electrode, concentration of the salt solution and the temperature. Therefore, certain standard conditions are considered. The salt solution of 1M concentration is taken at 25°C temperature. The electrode potential measured under these standard conditions is called **standard electrode potential**. It is denoted by E° .
- Depending on whether the loss or gain of electrons takes place in the electrode system, the standard electrode potential may be oxidation potential or reduction potential. Oxidation potential and reduction potential for an electrode are equal in magnitude with opposite sign. However, according to IUPAC convention, usually, reduction potentials are considered for the various electrodes. Therefore,

standard electrode potentials correspond to standard reduction potentials only.

- A voltaic or galvanic cell is constructed by combining two electrode systems where the potential difference between the two electrode systems can be measured by means of an voltmeter and this potential difference of the given cell is called **cell emf or cell potential**. According to IUPAC convention, emf of a cell is given in terms of standard reduction potentials.
- **emf of a cell = SRP of cathode – SRP of anode = $E^{\circ}_{\text{RHE}} - E^{\circ}_{\text{LHE}}$**
- Both cations and anions get discharged at the electrodes. Cations get reduced and anions get oxidized during discharge. The actual potential required for the discharge of ion at the electrode is known as **discharge potential** of the ion.
 - (i) The electrochemical series in which cations are arranged according to their discharge potential is called **electropositive series**.
 - (ii) The electrochemical series in which anions are arranged according to their discharge potential is called **electronegative series**.
 - (iii) Every atom or ion has its specific value of discharge potential.
- **At the top of the electrochemical series**
 - (a) Metals placed at the top of electrochemical series have greater tendency to lose electrons and thus the cations formed have higher values of discharge potential.
 - (b) Negative radicals/anions placed at the top have lesser tendency to get neutralised and hence they possess high discharge potential.
- **At the bottom of electrochemical series**
 - (a) Metals placed at the bottom of electrochemical series have lesser tendency to lose electrons and thus the cations formed have low discharge potential.
 - (b) Negative radicals/anions placed at the bottom have greater tendency to get neutralised and hence they possess low discharge potential.
- **Representation of cell:** According to IUPAC convention, oxidation half cell is written first by writing metal followed by metal ion separated by a single vertical line. The reduction half cell is written later by writing metal ion followed by metal. The two half cells are separated by a double vertical line which indicates salt bridge.

Example: Daniel cell: $\text{Zn}_{(s)} \mid \text{Zn}^{+2}_{(aq)} \parallel \text{Cu}^{+2}_{(aq)} \mid \text{Cu}_{(s)}$

○ Applications of electrochemical series

- (i) **Prediction of cell reaction:** By coupling the electrodes whose potentials are known, standard emf of the cell can be calculated. Since the emf of a cell is always positive, accordingly RHE and LHE are chosen. LHE involves oxidation half reaction and RHE involves reduction half reaction. Therefore, the cell reaction can be predicted from the relative positions of the electrodes in the electrochemical series.
- (ii) **Selective discharge of ions during electrolysis:** The cations with lower discharge potential get discharged at the cathode in preference to the one with higher discharge potential. Similarly, the anions with lower discharge potential get discharged at the anode.
- Apart from the position of an electrode in the electrochemical series, other factors also affect the preferential discharge of ions at the respective electrodes.
 - (a) **Nature of electrodes:** Platinum and graphite are considered as inert electrodes as they do not undergo reaction with the electrolyte. In such case, the discharge of ions at the respective electrodes perfectly follows the order of discharge potentials. However, when active electrodes are taken, the anode component gets oxidized to give the respective product.

Nature of the anode can be of two types:

- (i) active anode
- (ii) inactive (an inert) anode

- **Active anode:** In case of some anodes, anode itself dissolves in the electrolyte instead of the discharge of anions. This type of anode is called **active anode**. Hence, active anodes are used for electrorefining process. Impure copper is used as anode in the process of electrorefining of copper.
- **Inactive anode:** Metal like platinum or non-metal like graphite are highly chemically inert. When these anodes are used, anions get discharged depending on their discharge potential or concentration.

- (b) **Effect of concentration:** When a highly concentrated solution of an electrolyte is taken, the ion with a higher discharge potential, may get discharged at the electrode, in preference to the ion with a lower discharge potential, due to the higher concentration of the former ions in the solution. This is possible only when the difference in discharge potentials of ions is less.

○ **Applications of electrochemistry**

- (i) **Electroplating:** It is an electrolytic process of depositing a thin film of metal like gold, silver, nickel on other metals like iron, copper for different purposes.

○ **Applications of electroplating**

- (a) **For anti corrosion:** Coating a metal with other metal induces anti-corrosive properties.
 (b) **For decorative purposes:** Less valuable metals are electroplated with costly ones for giving the articles an elegant appearance.

Example: Gold over brass.

○ **Conditions to be maintained during electroplating**

- (a) The article to be electroplated is always made the cathode in electrolysis since the metal is deposited at the cathode.
 (b) The metal (like Ni, Ag, Au), which is to be electroplated on the given metal is always placed as anode. Since metal anode continuously dissolves into the solution, it has to be replaced periodically.
 (c) The electrolyte solution must contain the metal ions like Ag, Au, Ni since these ions travel towards cathode and get deposited on the metal placed as cathode.
 (d) Less amount of current is supplied for longer time. It helps to reduce the uneven deposition of metal.
 (e) The surface of the article to be coated should be cleaned properly for an effective coating.
 (f) An acid containing the same negative radical which is present in the electrolyte is required to be added to prevent the hydrolysis of the electrolyte.
 (g) Only direct current is to be used because alternating current causes discharge or ionization on alternate electrode. Hence no effective coating takes place on cathode.
- (ii) **Electrolytic refining:** Electrolysis can also be used for refining metals containing impurities. They can be purified electrolytically.

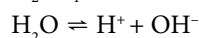
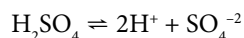
Example: Purification of copper.

Electrolytic refining of copper metal

Electrolyte: Acidified copper sulphate ($\text{CuSO}_4 + \text{H}_2\text{SO}_4$) solution.

Electrodes: Impure copper rod as anode and thin strip of pure copper rod as cathode.

Dissociation of electrolyte: $\text{CuSO}_4 \rightleftharpoons \text{Cu}^{+2} + \text{SO}_4^{-2}$



Reaction at the cathode: $\text{Cu}^{+2} + 2\text{e}^- \rightarrow \text{Cu}$

The Cu^{+2} ions in the solution move towards cathode and are deposited there by reduction.

Reaction at the anode: $\text{Cu} - 2\text{e}^- \rightarrow \text{Cu}^{+2}$

- (iii) **Electrometallurgy:** Electrolysis can also be used in the extraction of metals, which are at the bottom of electrochemical series.

Example: Na, K, Al, Ca, Mg, etc.

- (iv) **Anodising:** Anodising technique is another application of electrolysis. In this technique aluminium article is taken as anode and sulphuric acid as electrolyte. During electrolysis hydrogen is liberated at the cathode and oxygen at the anode. The liberated oxygen combines with anode that is aluminium forming a black thin film of aluminium oxide on the surface of anode. This aluminium oxide layer makes the aluminium surface resistant to corrosion and abrasion.

○ **Applications of anodising**

- (a) For decorative purposes: To achieve a coloured surface for gift articles
 (b) Household appliances: Anodized pressure cooker, anodised pan
 (c) For the manufacture of name plates

- **Batteries:** Various types of batteries are used in watches, transistor radios, cars and other automobiles. Some batteries can be recharged and some cannot be recharged.

The most common type of battery consists of zinc rod dipped in a paste of zinc chloride and ammonium chloride. This entire set up is kept in contact with a graphite rod surrounded by a mixture of MnO_2 and graphite powder. Cell emf is around 1.5 V.

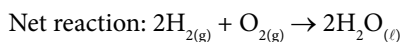
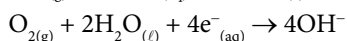
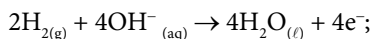
Other type of batteries are button shaped cells having emf of 1.6 V. A common car battery consists of PbO_2 in contact with H_2SO_4 .

○ **Fuel cell**

Example: Hydrogen-oxygen fuel cell.

In hydrogen-oxygen fuel cell, platinum electrodes are placed in a solution of an alkali. Electricity is generated by means of the following cell reactions.

Cell reactions involved



Solved Examples

1. Hydrogen peroxide decomposes to water and oxygen. The uncatalyzed reaction has activation energy of 86 kJ/mole. The activation energy values in the presence of acetanilide is 112 kJ/mole and in the presence of MnO_2 it is 49 kJ/mole. What conclusion can you draw from the above observations?

☞ **Solution:** The activation energy of a catalyzed reaction in the presence of MnO_2 catalyst is 49 kJ/mole which is much less than the activation energy of an uncatalysed reaction that is 86 kJ/mole. This shows that the rate of decomposition of H_2O_2 is increased in the presence of MnO_2 and hence it is a positive catalyst. The activation energy of catalyzed reaction in the presence of acetanilide is 112 kJ/mole which is much greater than that of an uncatalysed reaction. This shows that the rate of decomposition of H_2O_2 is decreased in the presence of acetanilide and hence it is a negative catalyst.

2. Assuming that $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ is a single step reaction, what will be the rate of reaction when the volume of the reaction vessel is reduced to 1/4th of the initial value? The original rate of reaction is 64 mole $\ell^{-1} \text{ s}^{-1}$.

☞ **Solution:** $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
The rate of the reaction $r = k[\text{NO}]^2 [\text{O}_2]$, as it is a single step reaction.

When the volume of the reaction vessel is reduced to 1/4th of the initial volume, the concentration of each reactant is increased by 4 times. Since the reaction is 2nd order with respect to NO and 1st order with respect to O_2 , the rate of reaction increases by 16 times for NO and 4 times for O_2 . On the whole, the rate of reaction increases by 64 times. The original rate of reaction is 64 mole $\ell^{-1} \text{ s}^{-1}$ and the new rate of reaction is 64 times more than this. $r_2 = 64 \times 64 = 4096 = 4.096 \times 10^3$ mole $\ell^{-1} \text{ sec}^{-1}$.

3. If K_c for the formation of HI from H_2 and I_2 each is 64, then calculate K_c for the decomposition of 1 mole of HI.

☞ **Solution:** $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ $1/2 \text{H}_2 + 1/2 \text{I}_2 \rightleftharpoons \text{HI}$
$$\Rightarrow K_{c_1} = \frac{[\text{HI}]^2}{[\text{H}_2]^1 [\text{I}_2]^1}$$

$$\Rightarrow K_{c_2} = \frac{[\text{HI}]}{[\text{H}_2]^{1/2} [\text{I}_2]^{1/2}}$$

$$\Rightarrow K_{c_2} = \frac{1}{\sqrt{K_{c_1}}} = \frac{1}{\sqrt{64}} = \frac{1}{8} = 0.125$$

4. In the reaction $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$, the dissociation of N_2O_4 was found to be 40% at equilibrium when the reaction is conducted in a 2 ℓ container at 300 K. Find the equilibrium constant and the number of moles of reactants and products.

☞ **Solution:**
$$\begin{array}{ccc} \text{N}_2\text{O}_4 & \rightleftharpoons & 2\text{NO}_2 \\ \text{Initial moles} & & 1 \qquad \qquad 0 \end{array}$$

Number of moles of N_2O_4 and NO_2 at equilibrium
 $1 - 0.4 = 0.6$ and 0.8 respectively

Concentration at equilibrium $0.6/2 = 0.3$

$0.8/2 = 0.4$

$$\therefore K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} = \frac{(0.4)^2}{0.3} = 0.533 \text{ mole } \ell^{-1}$$

5. (a) What is the effect of pressure on the equilibrium of the reaction of nitrogen and oxygen to give nitric oxide?
(b) In a reversible reaction, some amount of heat energy is liberated in the forward reaction. Name the reaction. What change in temperature favours the forward reaction?

☞ **Solution:** (a) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$

As the total number of moles on reactants side and products side is same, there is no effect of pressure on the equilibrium.

(b) In a reversible reaction, evolution of heat energy indicates that it is an exothermic reaction and $\Delta H = -ve$.

For example, $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D} + \text{Energy}$

Hence, low temperature favours the formation of products.

6. Explain the mechanism of electrolysis of molten sodium hydroxide.

☞ **Solution:** Molten sodium hydroxide dissociates to give Na^+ and OH^- ions. Na^+ ions go towards cathode while OH^- ions go towards anode.

Reaction at anode : $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4e^-$

Reaction at cathode : $4\text{Na}^+ + 4e^- \rightarrow 4\text{Na}$

7. When concentrated solution of cupric chloride is taken, chlorine gets liberated at anode, in contrast to a dilute solution where oxygen is liberated. However, when aqueous solution of CuSO_4 is taken, only oxygen is liberated at anode irrespective of concentration. How do you account for this?

👉 **Solution:** An aqueous solution of cupric chloride contains Cl^- ions, OH^- ions, Cu^{+2} ions and H^+ ions. Due to lower discharge potential of OH^- than Cl^- , oxygen gas is liberated at anode in preference to chlorine. However, in the concentrated solution, as the concentration of OH^- ions is very low, only chlorine gets liberated at anode. This is possible because the difference between discharge potentials of Cl^- and OH^- is only marginal. An aqueous solution of CuSO_4 contains Cu^{+2} , H^+ ,

OH^- and SO_4^{-2} ions. Due to large difference in discharge potentials between SO_4^{-2} and OH^- , only OH^- ions get discharged at anode irrespective of the concentration of the electrolyte.

8. When any strong electrolyte is subjected to electrolysis, are equal number of moles of products formed at cathode and anode for the passage of same quantity of electricity? Explain.

👉 **Solution:** When a strong electrolyte is subjected to electrolysis, it is not necessary that equal number of moles of cathodic and anodic products are formed. It depends on the relative charges of cation and anion in that electrolyte and the number of electrons involved in the respective cathodic and anodic reactions.

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- With rise in temperature, the rate of reaction generally _____.
 (1) increases
 (2) decreases
 (3) does not change
 (4) increase first and decrease
- _____ is the unit for the rate of a chemical reaction.
 (1) Mole $\ell^{-1}\text{s}$ (2) Mole $\ell^{-1}\text{s}^{-1}$
 (3) Mole ℓs (4) Mole ℓ^{-1}
- The rate of reaction depends on the
 (1) temperature of the reaction
 (2) catalyst
 (3) concentration of the reactants
 (4) All the above
- In the formation of NO and O_2 from NO_2 the rate of production of
 (1) NO and O_2 are equal.
 (2) NO is double the rate of consumption of NO_2 .
 (3) NO is twice the rate of production of O_2 .
 (4) O_2 is twice the rate of production of NO.
- The rate of reaction for the reaction between ionic compounds cannot be determined because they are generally
 (1) immeasurably slow reactions
 (2) moderately slow reactions
 (3) instantaneous reactions
 (4) not precipitation reactions
- If $r = -\frac{3}{2} \frac{\Delta[A]}{\Delta t} = -5 \frac{\Delta[B]}{\Delta t} = +\frac{7}{3} \frac{\Delta[C]}{\Delta t}$, which of the following is the corresponding stoichiometric equation?
 (1) $2/3 \text{ A} + 1/5 \text{ B} \rightarrow 3/7 \text{ C}$
 (2) $2/3 \text{ A} + 5/2 \text{ B} \rightarrow 7/3 \text{ C}$
 (3) $3/2 \text{ A} + 5/2 \text{ B} \rightarrow 7/3 \text{ C}$
 (4) $7/3 \text{ C} + 5/2 \text{ B} \rightarrow 3/2 \text{ A}$
- Consider the reaction
 $\text{A} + \text{B} \rightarrow \text{C}; \text{X} + \text{Y} \rightarrow \text{Z}$
 If the reaction between X and Y proceeds faster than A and B, then which among the following statements is true?

- The activation energy of X and Y molecules is high.
 - More number of X and Y molecules possess threshold energy.
 - The activation energy of A and B molecules is less.
 - More number of A and B molecules possess threshold energy.
- Electrochemical equivalents of Mg and Al have been given. Find the correct alternative for their values from given below.
 (a) $1.24 \times 10^{-4} \text{ g/C}$ (b) $93.26 \times 10^{-4} \text{ g/C}$
 (c) $12.4 \times 10^{-4} \text{ g/C}$ (d) $9.326 \times 10^{-5} \text{ g/C}$
 (e) $2.48 \times 10^{-5} \text{ g/C}$.
 (1) a and b (2) b and c
 (3) a and d (4) d and e
 - The equilibrium constant for the given reaction, $\text{CaCO}_{3(s)} \rightleftharpoons \text{CaO}_{(s)} + \text{CO}_{2(g)}$ is given by
 (1) $K_c = \frac{[\text{CaO}][\text{CO}_2]}{[\text{CaCO}_3]}$ (2) $K_c = \frac{[\text{CaO}]}{[\text{CaCO}_3]}$
 (3) $K_c = [\text{CO}_2]$ (4) $K_c = \frac{[\text{CaO}]}{[\text{CO}_2]}$
 - Identify the common property for a chemical reaction at dynamic equilibrium.
 (1) The measurable properties like concentration, density, colour, pressure etc remain constant at constant temperature.
 (2) The forward and backward reactions take place with the same rate.
 (3) It can be achieved from both directions
 (4) All the above
 - Identify the equilibrium in which K_c has no units.
 (1) Decomposition of HI
 (2) Decomposition of PCl_5
 (3) Decomposition of NH_3
 (4) Decomposition of CaCO_3
 - The equilibrium constant for the reactions
 $\text{N}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{NO}_{(g)}$ and $\text{NO}_{(g)} \rightleftharpoons \frac{1}{2}\text{N}_{2(g)} + \frac{1}{2}\text{O}_{2(g)}$
 are K and K^1 respectively, the relation between K and K^1 is

$$(1) K = (K^1)^2 \quad (2) K = \left(\frac{1}{K^1}\right)^2$$

$$(3) (K)^2 = K^1 \quad (4) K^1 = \left(\frac{1}{K}\right)^2$$

13. In the reaction $N_2O_4 \rightleftharpoons 2NO_2$, the degree of dissociation of N_2O_4 increases with

- (1) increase in pressure
- (2) decrease in temperature
- (3) increase in volume
- (4) presence of catalyst

14. For a reaction $A + B \rightleftharpoons C + D$, if the activation energy of backward reaction is more than that of forward reaction, the forward reaction is

- (1) endothermic
- (2) exothermic
- (3) reaction need not necessarily involve heat changes
- (4) Cannot be predicted

15. 1 faraday = _____ coulombs.

- (1) 10000
- (2) 95000
- (3) 96.5
- (4) 96500

16. Identify the set of metals which require same amount of charge for the deposition of one mole of metals.

- (1) Na, Ag, Al
- (2) Zn, Cu, Ag
- (3) Al, Cu, Zn
- (4) Mg, Zn, Cd

17. The amount of metals deposited when 965 C of electricity is passed through NaCl and $AgNO_3$ solutions are _____ and _____ respectively.

- (1) 23 g, 108 g
- (2) 11.5 g, 54 g
- (3) 0.23 g, 1.08 g
- (4) 2.3 g, 10.8 g

18. Identify the pair of electrolytes in which one contains only ions and the other contains unionized molecules in addition to ions respectively

- (1) Potassium hydroxide, nitric acid
- (2) Carbonic acid, potassium chloride
- (3) Sodium hydroxide, carbonic acid
- (4) Barium sulphate, acetic acid

19. Identify the substances which are usually liberated at the cathode during the process of electrolysis.

- (1) Zinc and chlorine
- (2) Sodium and hydrogen
- (3) Oxygen and chlorine
- (4) Hydrogen and chlorine

20. The passage of 1.5 Faradays of electricity corresponds to the flow of how many electrons?

- (1) 6×10^{23}
- (2) 9×10^{23}
- (3) 12×10^{23}
- (4) 3×10^{23}

21. The number of gram moles of hydrogen liberated by the passage of 1 Faraday of electricity is

- (1) 0.5
- (2) 1
- (3) 2
- (4) 4

22. The liberation of 1 mole of chlorine requires how many Faradays of electricity?

- (1) 0.5 Faraday
- (2) 0.25 Faradays
- (3) 2 Faradays
- (4) 4 Faradays

23. A voltaic cell is represented as $A_{(s)} | A^{+2}_{(aq)} || B^{+2}_{(aq)} | B_{(s)}$. Which of the following statements is false regarding the above cell?

- (1) The double vertical line indicates salt bridge
- (2) A is called the anode and B is called the cathode
- (3) The cell reactions are represented as $A^{+2} + 2e^- \rightarrow A$ & $B \rightarrow B^{+2} + 2e^-$
- (4) None of the above

24. Electrolysis of which of the following aqueous solutions is not associated with the liberation of hydrogen gas at cathode?

- (1) NaCl
- (2) $CuCl_2$
- (3) $ZnSO_4$
- (4) Both (1) and (2)

25. Identify the pair of electrolytes giving the same anodic products during electrolysis.

- (1) Brine solution and copper sulphate solution
- (2) Dilute NaCl solution and molten KCl
- (3) Molten NaCl and conc. $CuCl_2$ solution
- (4) None of these

26. Identify the true statement regarding Daniel cell.

- (1) Zinc ions flow from Zn electrode to copper electrode
- (2) K^+ ions move from salt bridge to Cu/Cu^{+2} half cell.
- (3) Oxidation takes place at copper electrode.
- (4) Flow of current takes place from copper electrode to zinc electrode.

27. In the electrolysis of acidulated water, SO_4^{-2} ions do not get discharged at anode. Identify the correct reason.

- (1) SO_4^{-2} ions have lower discharge potentials
- (2) SO_4^{-2} ions have higher discharge potential

- (3) The concentration of SO_4^{2-} ions is very less in the electrolyte
 (4) SO_4^{2-} ions get neutralized by H^+ ions.
28. Which of the following is not an electrochemical process?
 (1) Transmission of nerve impulses in human body
 (2) Rusting of iron
 (3) Lightning
 (4) None of the above
29. Which of the following reasons can be attributed to prevention of rusting by zinc coating?
 (1) Zinc acts as cathode
 (2) Zinc acts as anode
 (3) Iron acts as anode
 (4) Both (1) and (3)
30. When lead storage battery is discharged
 (1) SO_2 is evolved
 (2) Lead sulphate is consumed
 (3) Lead is formed
 (4) H_2SO_4 is consumed
31. According to the electrochemical concept, corrosion occurs at _____.
 (1) Anode area of metal
 (2) Cathode area of metal
 (3) both cathodic and anodic areas of metal
 (4) neither cathodic area nor anodic area
32. Rusting takes place rapidly in
 (1) pure water
 (2) pure oxygen
 (3) air and moisture
 (4) air and saline water
33. The standard oxidation potential of A, B, C, D are -0.55 , 0.86 , -0.21 and $+0.38$ volts respectively. Identify the strongest reducing agent.
 (1) A (2) B
 (3) C (4) D
34. If 5.6ℓ of oxygen is liberated during the electrolysis of acidified water, the volume of hydrogen liberated at the cathode is
 (1) 5.6ℓ
 (2) 2.8ℓ
 (3) 11.2ℓ
 (4) 22.4ℓ
35. The emf of a voltaic cell can be given by _____.
 (1) SRP of cathode – SRP of anode
 (2) SRP of cathode + SRP of anode
 (3) SOP of cathode – SOP of anode
 (4) SOP of cathode + SOP of anode

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The rusting of iron is a _____ reaction.
 (1) very slow (2) slow
 (3) moderate (4) fast
2. From the standard electrode potential values of the electrodes given, select an option representing their decreasing order discharge potential.
 (a) $A, E^\circ = 2.32 \text{ v}$ (b) $B, E^\circ = 1.36 \text{ v}$
 (c) $C, E^\circ = 1.07 \text{ v}$ (d) $D, E^\circ = 0.43 \text{ v}$
 (1) acbd (2) abdc
 (3) adbc (4) abcd
3. For a reaction $A + B \rightarrow C$, the rate law is written as $r = k[A]^2[B]$. Doubling the concentration of 'A' without changing concentration of 'B' increases the rate of reaction by
 (1) 2 times (2) 4 times
 (3) 8 times (4) 16 times
4. The units of rate constant of a reaction when the rate of reaction is directly proportional to the concentration of one of the reactants is
 (1) $\text{litre mole}^{-1}\text{sec}^{-1}$
 (2) $\text{mole litre}^{-1}\text{sec}^{-1}$
 (3) sec^{-1}
 (4) $\text{litre}^2\text{mole}^{-2}\text{sec}^{-1}$
5. Which among the following reactions is an example of instantaneous reaction under normal conditions?
 (1) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 (2) $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$
 (3) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 (4) $\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6$

6. For the reaction $A \rightarrow B$, identify the correct sequence of steps for the calculation of average rate of reaction.
- Plotting a graph of concentration of 'A' at various time intervals.
 - Identification of C_2 and C_1 at different time intervals t_2 and t_1 respectively by reading the graph
 - Calculation of $\frac{C_2 - C_1}{t_2 - t_1}$
 - Finding out the experimental values of concentrations of 'A' at regular intervals.
- d b c a
 - d a b c
 - c b a d
 - a b c d
7. The units of K_c for the decomposition of solid ammonium bisulphide are _____
- Mole²/ℓ²
 - ℓ²/Mole²
 - Mole/ℓ
 - ℓ/Mole
8. The units of K_c for the decomposition of potassium nitrate is same as the units of K_c for the
- decomposition of sulphur trioxide
 - decomposition of hydrogen iodide
 - decomposition of ammonium nitrite
 - formation of nitrogen dioxide from nitric oxide and oxygen
9. Which of the following K_c values corresponds to the maximum yield of the products?
- 9.2×10^2
 - 1.8×10^{-15}
 - 2.8×10^3
 - 3.4×10^{-25}
10. The favourable condition for the reaction $N_2 + O_2 \rightleftharpoons 2NO$ – heat is _____
- increase in the concentration of reactants
 - increase in pressure
 - decrease in temperature
 - None of the above
11. According to Le Chatelier's principle,
- an increase in pressure always causes a change in position of equilibrium for any reaction
 - the yield of NH_3 decreases from its constituents at lower temperature
 - an increase in temperature causes a decrease in the value of K_c for an exothermic reaction
 - the K_c is decreased for the reaction $A_{(s)} + B_{(g)} \rightleftharpoons C_{(g)}$ if the concentration of A is increased.
12. In which among the following reactions the formation of product is favoured by decreasing the temperature or volume?
- $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)} - q$
 - $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)} - q$
 - $4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)} \Delta H$ is -ve
 - $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \Delta H$ is -ve
13. K_c for the reaction $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \rightleftharpoons NH_{3(g)}$ is
- $K_c = \frac{[NH_3]}{[N_2][H_2]}$
 - $K_c = \frac{[N_2][H_2]}{[NH_3]}$
 - $K_c = \frac{[NH_3]}{[N_2]^{\frac{1}{2}}[H_2]^{\frac{3}{2}}}$
 - $K_c = \frac{[N_2]^{\frac{1}{2}}[H_2]^{\frac{3}{2}}}{[NH_3]}$
14. Consider the reaction: $2Cu(NO_3)_{2(s)} \rightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$, which of the following gives the value of K_c of this equilibrium?
- $K_c = \frac{[CuO]^2 [NO_2]^2 [O_2]}{[Cu(NO_3)_2]^2}$
 - $K_c = \frac{[Cu(NO_3)_2]^2}{[CuO]^2 [NO_2]^4 [O_2]}$
 - $K_c = [CuO][NO_2]^4 [O_2]$
 - $K_c = [NO_2]^4 [O_2]$
15. In reversible reactions concentration of
- reactants decreases with time at equilibrium.
 - products increases with time at equilibrium.
 - reactants decreases and then increases with time at equilibrium.
 - reactants and products are constant at equilibrium.
16. For the reaction involving the formation of sulphur trioxide from sulphur dioxide and oxygen, the rate of reaction with respect to reactants is given as
- $r = -\frac{1}{2} \frac{\Delta[O_2]}{\Delta t}$
 - $r = \frac{\Delta[SO_2]}{\Delta t}$
 - $r = \frac{-\Delta[SO_2]}{\Delta t}$
 - $r = -\frac{1}{2} \frac{\Delta[SO_2]}{\Delta t}$
17. The amount of Na produced by the passage of 2 moles of electrons through the fused NaCl is _____ g
- 23
 - 46
 - 11.5
 - 34.5

18. The order of ease of oxidation of the ions F^- , OH^- , Br^- , SO_4^{2-} is _____.
 (1) $SO_4^{2-} > F^- > Br^- > OH^-$
 (2) $SO_4^{2-} < Br^- < OH^- < F^-$
 (3) $SO_4^{2-} < F^- < Br^- < OH^-$
 (4) $OH^- < Br^- < F^- < SO_4^{2-}$
19. The standard electrode potentials of the electrodes are given below. Arrange them in decreasing order of ease of oxidation.
 (a) Electrode – I, $E^\circ = -2.89V$
 (b) Electrode – II, $E^\circ = -0.16V$
 (c) Electrode – III, $E^\circ = 0.77V$
 (d) Electrode – IV, $E^\circ = -2.93V$
 (e) Electrode – V, $E^\circ = -1.67V$
 (1) c b e a d (2) d a e b c
 (3) c e a d b (4) c b a d e
20. Pairs of electrodes and their corresponding standard electrode potentials are given. Arrange the cells constructed by these electrodes in increasing order of emf values.
 (a) Electrode $\rightarrow A$, $E^\circ = -2.92 V$ and Electrode $\rightarrow B$, $E^\circ = -2.71 V$
 (b) Electrode $\rightarrow C$, $E^\circ = -0.760 V$ and Electrode $\rightarrow D$, $E^\circ = -0.44 V$
 (c) Electrode $\rightarrow B$, $E^\circ = -2.71 V$ and Electrode $\rightarrow D$, $E^\circ = -0.44 V$
 (d) Electrode $\rightarrow A$, $E^\circ = -2.92 V$ and Electrode $\rightarrow C$, $E^\circ = -0.76 V$
 (1) b a d c (2) a b d c
 (3) b d a c (4) b d c a
21. The process used in purifying metals by electrolysis is called _____.
 (1) electroplating (2) electrometallurgy
 (3) electrorefining (4) electrodeposition
22. The electrolytic process by which an oxide of metal is coated over metal surface is called _____.
 (1) electrolysis (2) electroplating
 (3) anodising (4) electrorefining
23. Identify the electrolyte with the highest conductivity among the following.
 (1) $0.1M CH_3COOH$ (2) $0.1 M HCl$
 (3) Water (4) $0.1M NH_4OH$
24. If a battery of $1.6 V$ is connected to Daniel cell, current flows
 (1) into the cell.
 (2) out of the cell.
 (3) neither in nor out of the cell.
 (4) both ways.
25. The approximate ratio of Ag, Al, Cu deposited at the electrodes when these electrolytic cells are connected in series is
 (1) $6 : 2 : 3$ (2) $12 : 1 : 3.5$
 (3) $4 : 1 : 2.4$ (4) $12 : 1 : 7$
26. In which of the following cases conductivity decreases with an increase in temperature?
 (1) Fused NaCl (2) Cadmium
 (3) NaOH (4) NH_4OH
27. Identify the reaction taking place at cathode in fuel cell.
 (1) $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$
 (2) $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$
 (3) $O_2 + 2H_2O + 4e^- \rightarrow 4OH^- + H^+$
 (4) $4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$
28. A metal 'M' cannot be reduced by any reducing agents such as H_2 , CO and carbon. It has to be extracted by the electrolysis of fused metals salts. Identify 'M'.
 (1) Zn (2) Ca
 (3) Cu (4) Hg
29. Which of the following is the preferred electrolyte for silver plating?
 (1) $AgCl + HCl$ (2) $AgNO_3 + HNO_3$
 (3) Ag_2SO_4 (4) $AgCN + NaCN$
30. The metals with the highest and the lowest SRP values are
 (1) silver and lithium
 (2) fluorine and lithium
 (3) fluorine and silver
 (4) silver and potassium
31. The ions associated with salt bridge are
 (1) sodium. (2) potassium.
 (3) calcium. (4) magnesium.
32. The pair of ions which discharge with the minimum and maximum ease
 (1) Sulphate and hydroxide
 (2) Nitrate and chloride
 (3) Sulphate and chloride
 (4) Nitrate and hydroxide

33. The electrode reaction associated with the retention of blue colour of the electrolyte during electrolysis of CuSO_4 solution with copper electrodes is

- (1) $\text{Cu}^{+2} + 2\text{e}^- \rightarrow \text{Cu}$
- (2) $\text{Cu} \rightarrow \text{Cu}^{+2} + 2\text{e}^-$
- (3) $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
- (4) $\text{SO}_4^{-2} \rightarrow \text{SO}_2 + \text{O}_2 + 2\text{e}^-$

34. An electrolytic cell is taken with two graphite rods inserted in it and connected to opposite terminals of a battery. An electric bulb is also introduced in the circuit. Different substances are taken in the cell and the conductivity is tested. Identify the case where the bulb glows most brilliantly.

- (1) Molten lead bromide
- (2) Molten wax
- (3) Kerosene oil
- (4) Barium sulphate in water

35. The number of positively and negatively charged ions present in 1 ℓ of 0.1 M aluminium sulphate solution are

- (1) 1.2×10^{22} + ve ions and 1.8×10^{22} – ve ions.
- (2) 1.2×10^{23} + ve ions and 1.8×10^{23} – ve ions.
- (3) 1.2×10^{23} + ve ions and 1.8×10^{23} – ve ions.
- (4) 1.2×10^{21} + ve ions and 1.8×10^{21} – ve ions.

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

1. 1	2. 2	3. 4	4. 3	5. 3	6. 1	7. 2	8. 3	9. 3	10. 4
11. 1	12. 2	13. 3	14. 2	15. 4	16. 4	17. 3	18. 3	19. 2	20. 2
21. 1	22. 3	23. 3	24. 2	25. 3	26. 4	27. 2	28. 3	29. 2	30. 4
31. 1	32. 4	33. 2	34. 3	35. 1					

PRACTICE EXERCISE 6 (B)

1. 1	2. 4	3. 2	4. 3	5. 3	6. 2	7. 1	8. 1	9. 3	10. 1
11. 3	12. 4	13. 3	14. 4	15. 4	16. 4	17. 2	18. 3	19. 2	20. 2
21. 3	22. 3	23. 2	24. 2	25. 2	26. 2	27. 1	28. 2	29. 4	30. 1
31. 2	32. 1	33. 2	34. 1	35. 3					

Acids, Bases and Salts

SYNOPSIS

○ Arrhenius theory of Acids and Bases

- (i) An acid is a substance which contains hydrogen and produces H^+ ions in aqueous solution.

Example: $HCl \rightarrow H^+ + Cl^-$

- (ii) A base is a substance which produces OH^- ions in aqueous solution.

Example: $NaOH \rightarrow Na^+ + OH^-$

- (iii) All acids which ionize completely and hence produce more concentration of H^+ ions in their aqueous solutions are called **strong acids**. All acids which ionize partially and hence produce less concentration of H^+ ions are called **weak acids**.

Examples: (a) $HNO_3 \rightarrow H^+ + NO_3^-$
strong acid

(b) $CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$
weak acid

- (iv) All bases which ionize completely and hence produce more concentration of OH^- ions in their aqueous solutions are called **strong bases**. All bases which ionize partially and produce less concentration of OH^- ions are called **weak bases**.

Examples: (a) $KOH \rightarrow K^+ + OH^-$
strong base

(b) $NH_4OH \rightleftharpoons NH_4^+ + OH^-$
weak base

- (v) **Neutralization** is defined as the reaction between an acid and a base to give salt and water.

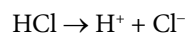
Example: $HCl + NaOH \rightarrow NaCl + H_2O$

The (neutralization) ions which remain unchanged during the reaction are called **spectator ions**.

Bronsted-Lowry theory of acids and bases:

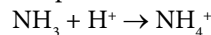
- (i) An acid is a substance which can donate one or more protons.

Example: HCl acts as a proton donor and hence is called an acid.



- (ii) A base is a substance which can accept one or more protons.

Example: NH_3 acts as a base as it is a proton acceptor.



- (iii) An acid on losing a proton produces a species which is called **conjugate base** of the acid.

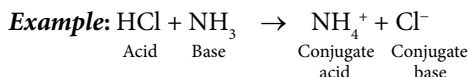
Example: $HCl \rightarrow H^+ + Cl^-$
Acid Conjugate base

- (iv) A base on accepting a proton produces a species which is called **conjugate acid** of the base.

Example: $NH_3 + H^+ \rightarrow NH_4^+$
Base Conjugate acid

- (v) **Neutralization** is defined as the transfer of a proton from an acid to base to form a conjugate

acid base pair. Since this theory mainly focuses on proton transfer, this is also known as **protonic concept of acids and bases**.



Lewis theory of acids and bases

- (i) An acid is a substance which can act as an electron pair acceptor.

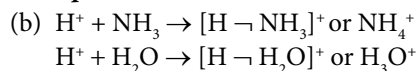
Examples: BF_3 , AlCl_3 etc.

- (ii) A base is a substance which can act as an electron pair donor.

Examples: NH_3 , H_2O etc.

- (iii) Acid base neutralization can be defined as the transfer of an electron pair from a base to an acid, which involves the formation of a coordinate covalent bond.

Examples:



○ Classification of acids and bases

Acids and bases can be further classified on the basis of certain properties

- **On the basis of strength:** Strength of an acidic or basic solution depends upon degree of dissociation. Degree of dissociation can be calculated as

Degree of dissociation =

$$\frac{\text{Amount dissociated (mole/l)}}{\text{Initial concentration (mole/l)}}$$

Thus based on the strength, acids and bases can be further classified into strong acids and weak acids, strong base and weak base respectively.

- (a) **Strong acids:** The acids which undergo nearly 100% or complete ionization in aqueous solutions are called **strong acids**. These produce a high concentration of H^+ ions per unit volume of the solution.

Example: $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$

- (b) **Weak acids:** The acids which undergo partial ionization in aqueous solutions are called **weak acids**. These produce low concentration of H^+ ions per unit volume of the solution.

Example: $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$

- (c) **Strong bases:** Bases which undergo nearly 100% or complete ionization in aqueous solutions are called **strong bases**. These produce a high

concentration of OH^- ions per unit volume of the solution.

Example: $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$

- (d) **Weak bases:** Bases which undergo partial ionization in aqueous solutions are called **weak bases**. These produce low concentration of OH^- ions per unit volume of the solution.

Example: $\text{NH}_4\text{OH}_{(\text{aq})} \rightleftharpoons \text{NH}_4^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$

- **On the basis of basicity and acidity:** Number of H^+ or H_3O^+ ions produced by ionization of one molecule of an acid in aqueous solution is called **basicity**. Basicity is also called Hydroxycity.

- (a) **Monobasic acids:** The acids which dissociate in aqueous solutions to produce one hydrogen ion or hydronium ion per molecule of the acid are called **monobasic acids**.

Examples: HCl , HBr , HNO_3 , HI , CH_3COOH

- (b) **Dibasic acids:** The acids which dissociate in aqueous solution to produce two hydrogen ions or hydronium ions per molecule of the acid are called **dibasic acids**.

Examples: H_2SO_4 , $\text{H}_2\text{C}_2\text{O}_4$, H_2SO_3 , H_2CO_3

- (c) **Tribasic acids:** The acids which dissociate in aqueous solution to produce three hydronium ions per molecule of acid are called **tribasic acids**.

Example: H_3PO_4

Number of OH^- ions produced by the ionization of one molecule of base in aqueous solution is called **acidity**. Acidity is also called proticity.

- (a) **Monoacidic bases:** The bases which dissociate in aqueous solution to produce one hydroxyl ion per molecule of the base are called **monoacidic bases**.

Examples: NaOH , KOH , NH_4OH

- (b) **Diacidic bases:** The bases which dissociate in aqueous solutions to produce two hydroxyl ions per molecule of the base are called **diacidic bases**.

Examples: $\text{Ca}(\text{OH})_2$, $\text{Cu}(\text{OH})_2$, $\text{Mg}(\text{OH})_2$

- (c) **Triacidic bases:** The bases which dissociate in aqueous solutions to produce three hydroxyl ions per molecule of base are called **triacidic bases**.

Examples: $\text{Al}(\text{OH})_3$, $\text{Fe}(\text{OH})_3$

○ On the basis of concentration

- (a) **Concentrated acid or base:** An aqueous solution that has a high percentage of acid or base and a low percentage of water is said to be a concentrated acid or concentrated base respectively.

(b) **Dilute acid or base:** An aqueous solution that has a low percentage of acid or base and a high percentage of water is said to be a dilute acid or dilute base respectively.

○ **General preparation methods of acids**

- (i) By synthesis/direct combination (for hydracids and binary acids)
- (ii) By the reaction of non-metallic (acidic) oxides with water
- (iii) By the oxidation of non-metals with oxyacids
- (iv) By the displacement of salts of more volatile acid with less volatile acid

○ **General preparation methods of bases**

- (i) By the action of water on metals
- (ii) By the action of metallic oxides on water
- (iii) By the action of oxygen on metals
- (iv) By the decomposition of metal carbonates
- (v) Using soluble metal salts and NaOH/KOH
- (vi) Strong heating of metal nitrates
- (vii) By the action of oxygen on metal sulphides

○ **Chemical properties of acids**

- (i) Metal oxide + Dilute acid \rightarrow Salt + Water
Metal hydroxide + Dilute acid \rightarrow Salt + Water
- (ii) Carbonate or Bicarbonate + Acid \rightarrow Salt + H_2O + $\text{CO}_2\uparrow$
- (iii) Metal sulphite or Bisulphite + Acid \rightarrow Salt + H_2O + $\text{SO}_2\uparrow$
- (iv) Metal sulphide or Bisulphide + Acid \rightarrow Salt + $\text{H}_2\text{S}\uparrow$
- (v) Active metal + Dilute Acid \rightarrow Salt + $\text{H}_2\uparrow$
- (vi) Metal chloride + Acid \rightarrow Salt + Hydrochloric acid
- (vii) Metal nitrate + Acid \rightarrow Salt + Nitric acid

○ **Chemical properties of bases**

- (i) Alkali + Non-metallic oxide \rightarrow Metal salt + H_2O
- (ii) Ammonium salt + Alkali \rightarrow Metal salt + H_2O + $\text{NH}_3\uparrow$
- (iii) Soluble metallic salt + Base \rightarrow Soluble salt + Insoluble hydroxide

○ **Uses of Acids and Bases**

Some important acids	Uses
Sulphuric acid	Manufacture of fertilizers, dyes, drugs, explosives, paints, chemicals, artificial fabrics etc
Hydrochloric acid	Printing, tanning and tinning industries

Some important acids

Uses

Nitric acid	Manufacture of dyes, explosives, drugs, fertilizers and chemicals
Acetic acid	Preservation of food and as a flavouring agent
Citric acid	Curdling milk, flavouring soft drinks and as medicine (source of vitamin C)
Carbonic acid	Used in soft drinks
Oxalic acid	Used as ink stain remover
Boric acid	Preservation of grains, to wash eyes
Benzoic acid	As food preservative
Tartaric acid	constituent of baking powder

Some important alkalis

Uses

NaOH	Manufacture of soap
KOH	Manufacture of soft soap and in alkaline batteries
NH_4OH	Used to remove grease stains from woollen clothes
$\text{Ca}(\text{OH})_2$	Manufacture of mortar, softening temporary hard water, neutralizing acidity of soils and as a general germicide
$\text{Mg}(\text{OH})_2$	Used as antacid for neutralizing gastric acidity
$\text{Al}(\text{OH})_3$	Used as foaming agent in fire extinguishers

○ **Neutralization:** It is the chemical reaction of acid and base to form salt and water while liberating heat. The relative amount of acids and bases undergoing neutralization depends on the actual concentration of H^+ or OH^- ions produced in the solution. If the acids and bases differ in their strengths, that is the degree of dissociation, then the concentration of H^+ and OH^- ions furnished by them also differs.

○ **Equivalent mass of an acid** is defined as the number of parts by mass of the acid which contains 1.008 parts by mass of the replaceable hydrogens. Thus, the equivalent mass of an acid can also be defined as the amount of acid which can furnish one mole of H^+ ions on ionization.

Calculation of equivalent masses

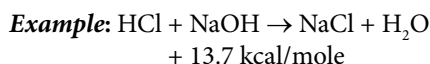
Equivalent mass of acid

$$= \frac{\text{Molecular mass}}{\text{Number of replaceable hydrogen ions in the given reaction}}$$

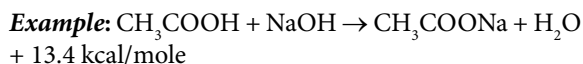
- **Equivalent mass of a base** is defined as the mass of the base which can furnish one mole of OH^- ions on ionization. In other words, one equivalent of an acid is always neutralized by one equivalent of a base.
Equivalent mass of base =

$$\frac{\text{Molecular mass}}{\text{Number of replaceable hydroxyl ions in the given reaction}}$$

- **Heat of neutralization:** A neutralization reaction is always associated with the liberation of heat. The amount of heat liberated when one equivalent of an acid reacts with one equivalent of a base is called **heat of neutralization**. For any strong acid-strong base reaction, the heat of neutralization has the same value that is 13.7 kcal/mole since the acid and base involved are completely ionized.



When a weak acid or a weak base is involved in the reaction, some amount of heat is utilized to ionize the acid or base to furnish ions. This is called **heat of ionization**. Therefore, the net heat released is less than the heat of neutralization for strong acid-strong base reaction.



$$\begin{aligned}\text{Heat of ionization} &= 13.7 - \text{net heat liberated} \\ &= 13.7 - 13.4 = 0.3 \text{ kcal/mole.}\end{aligned}$$

○ **Uses of neutralization**

- (i) Slaked lime ($\text{Ca}(\text{OH})_2$) is added to reduce the acidity of soil.
- (ii) Antacid tablets with $\text{Mg}(\text{OH})_2$ or cold milk are used to treat acidity by neutralizing HCl in stomach.
- (iii) Sting of ants/bees containing HCOOH (formic acid) can be neutralized by rubbing soap (NaOH).
- (iv) Sting of wasps that contains an alkali can be treated by neutralizing it with CH_3COOH .
- (v) Lithium hydroxide is used to neutralize CO_2 exhaled by astronauts in spaceships or submariners in submarines.

- **Normality:** The number of equivalents of a solute present in one litre of solution is called **normality**. It is denoted by 'N'

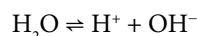
$$\text{Normality} = \frac{\text{Number of equivalents}}{\text{Volume of solution in litres}} = \text{Number}$$

$$\text{of equivalents} \times \frac{1000}{V \text{ in ml}}$$

$$= \frac{\text{Mass}}{\text{Equivalent mass}} \times \frac{1}{V \text{ in } \ell}$$

$$= \frac{\text{Mass}}{\text{Equivalent mass}} \times \frac{1000}{V \text{ in ml}}$$

- Normality of a diluted solution can be calculated by using the concept that the total number of equivalents before and after dilution remain equal. This is called **law of dilution**. V_1 and N_1 are the volume and the normality respectively of the concentrated solution. V_2 and N_2 are the volume and the normality respectively of the diluted solution. According to the law of dilution, $V_1 N_1 = V_2 N_2$.
- **Ionic product of water:** Water ionizes partially to give H^+ and OH^- ions. An equilibrium exists between the ionized and unionized molecules.



Applying the law of mass action to the above equilibrium, the equilibrium constant for the above reaction

$$\text{is, } K = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$

$K[\text{H}_2\text{O}] = K_w = [\text{H}^+][\text{OH}^-]$ where K_w is called ionic product of water.

At normal temperature (25°C), the concentration of H^+ and OH^- ions remains equal that is 10^{-7} M

$$\therefore [\text{H}^+] = [\text{OH}^-] = 10^{-7} \text{ mole}/\ell$$

$$K_w = [\text{H}^+][\text{OH}^-] = 10^{-7} \times 10^{-7} = 10^{-14} \text{ mole}^2/\ell^2$$

On adding a base, $[\text{OH}^-]$ increases and $[\text{H}^+]$ decreases but the product (K_w) remains constant at constant temperature.

- At 25°C ,

$$\text{Neutral solution} \rightarrow [\text{H}^+] = [\text{OH}^-] = 10^{-7} \text{ mole ion}/\ell.$$

$$\text{Acidic solution} \rightarrow [\text{H}^+] > [\text{OH}^-] < 10^{-7} \text{ mole ion}/\ell.$$

$$\text{Basic solution} \rightarrow [\text{H}^+] < [\text{OH}^-] > 10^{-7} \text{ mole ion}/\ell.$$

- Addition of acid or base does not change the value of K_w . On the addition of acid, when $[\text{H}^+]$ increases a corresponding decrease in $[\text{OH}^-]$ keeps the K_w value constant.

- pH is defined as the negative logarithm to base 10 of H^+ ion concentration or logarithmic reciprocal of H^+ ion concentration.

$$pH = -\log_{10} [H^+] \text{ or } \log_{10} \frac{1}{[H^+]}$$

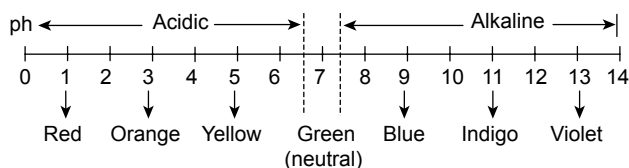
$$[OH^-] \text{ or } \log_{10} \frac{1}{[OH^-]}$$

- **Indicators:** Indicators are organic dyes that have one colour in acidic solutions and another colour in basic solutions. There are two types of indicators
- Common indicators
 - Universal indicators

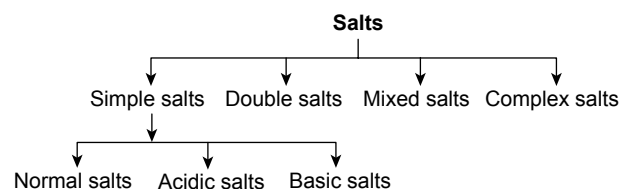
Indicator	Colour in acidic solution	Colour in basic solution
Litmus	Red	Blue
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink

- **Universal Indicator:** It is a mixture of organic dyes which gives different colours with solutions of different pH values. Hence this is more sensitive than other common indicators.

○ **Determination of pH using universal indicators**



○ **Classification of salts**



- **Simple salts:** The salts which contain only one type of positive ion and one type of negative ion are called **simple salts**. These are further classified into three types based on their chemical nature.

○ **Comparative study of normal, acidic and basic salts**

	Normal Salts	Acidic salts	Basic salts
Definition	The salts which do not contain replaceable hydrogen or hydroxyl ions	The salts which contain one or more replaceable hydrogen ions	The salts which contain one or more replaceable hydroxyl ions
Formation	By complete neutralization of acids and bases	By incomplete neutralization of acids and bases	By incomplete neutralization of acids and bases
Example	$2NH_4OH + H_2SO_4$ \downarrow $(NH_4)_2SO_4 + H_2O$	$NaOH + H_2SO_4$ \downarrow $NaHSO_4 + H_2O$	$Cu(OH)_2 + HNO_3$ \downarrow $Cu(OH)NO_3 + H_2O$
Composition	All ionisable hydrogens are replaced by a metal or NH_4^+ ion	Partial replacement of ionizable hydrogen by a metal or NH_4^+ ion	Partial replacement of ionisable hydroxyl groups by non-metal ions or negative radicals
Properties	Neutral in nature. Do not react with acids or bases	Acidic in nature. React with bases	Basic in nature. React with acids
Examples	$NaCl$, $(NH_4)_2SO_4$, $Al_2(SO_4)_3$	$NaHSO_4$, NH_4HSO_4	$Cu(OH)NO_3$, $Cu(OH)Cl$

- **Double salts:** The salts which contain more than one simple salt are called double salts.

Example: Potash alum – $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

- **Mixed salts:** The salts which contain more than one basic or acidic radicals are called **mixed salts**.

Example:

Sodium potassium carbonate ($NaKCO_3$) (Na^+ , K^+ and CO_3^{2-} radicals)

- **Complex salts:** The salts which contain one complex ion and one or more simple ions are called **complex**

salts. A complex salt dissociates into a complex ion and one or more simple ions.

Example: Sodium argento cyanide $\text{Na}[\text{Ag}(\text{CN})_2]$

- **Water of crystallization:** The fixed number of water molecules which combine with a crystal and are necessary for the maintenance of crystalline properties, but capable of being lost either at normal temperature or at a higher temperature is called water of crystallization.

Examples: Green vitriol ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$), blue vitriol ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) etc.

- **Hydrated salts and anhydrous salts:** The salts which contain water of crystallization are called **hydrated salts**
- **Efflorescence and deliquescence:** There are some hydrated crystals which lose some of the water of crystallization or all the water of crystallization on exposure to air at normal temperature. This phenomenon is known as **efflorescence** and the hydrated crystals which lose water molecules are called efflorescent substances.

Example: Glauber salt, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$

- Some crystalline salts absorb moisture on exposure to air and ultimately dissolve in it to form an aqueous solution. This phenomenon is called **deliquescence** and these crystalline salts are called deliquescent substances. These salts may or may not contain water of crystallization.

Examples: Hydrated magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), hydrated calcium chloride ($\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$) etc.

- There are certain substances which absorb moisture from air without changing their physical state. These substances are called **hygroscopic substances**. They may exist in solid or liquid state under normal temperature and pressure.

Examples: Calcium oxide (solid), concentrated sulphuric acid (liquid) etc.

- Hygroscopic substances which are used to remove water from the surroundings are called **desiccating agents**.

Examples: Calcium oxide and anhydrous calcium chloride

- **Salt hydrolysis:** The phenomenon in which a simple salt on dissolution in water forms a parent acid and a parent alkali resulting in acidic, basic or neutral solution is called **salt hydrolysis**. It is the most important property of salts.

Depending on the nature of the salts, it is classified into four types.

- Hydrolysis of salts of strong acids and weak bases:** This type of hydrolysis makes the solution acidic with $\text{pH} < 7$. (at 25°C)
Examples: CuSO_4 , $(\text{NH}_4)_2\text{SO}_4$, NH_4NO_3 , FeCl_3 etc.
 - Hydrolysis of salts of weak acids and strong bases:** This makes type of hydrolysis the solution basic and has a $\text{pH} > 7$ (at 25°C).
Examples: CH_3COONa , Na_2CO_3 , CH_3COOK ,
 - Hydrolysis of salts of strong acids and strong bases:** This type of hydrolysis makes the solution neutral with $\text{pH} = 7$ (at 25°C).
Examples: NaCl , K_2SO_4 , KNO_3
 - Hydrolysis of salts of weak acids and weak bases:** The exact value of pH of the solution depends upon the relative values of degree of dissociation of the acid and the base produced.
Examples: $(\text{NH}_4)_2\text{CO}_3$, $\text{CH}_3\text{COONH}_4$
- **Qualitative analysis of simple salts:** A simple salt contains an acidic radical (anion) and a basic radical (cation). The qualitative analysis of a simple salt involves identification of the constituent acidic and basic radicals of the salt.

- **Identification of some important anions**

Anion	Test	Reactions involved	Observation and Inference
Carbonate (CO_3^{2-})	Action of dilute HCl	$\text{CaCO}_3 + 2\text{HCl}$ \downarrow $\text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$	Colourless gas with brisk effervescence which puts off burning splinter and turns lime water milky. CO_2 gas is evolved.
Chloride (Cl^-)	Action of conc. H_2SO_4	$\text{BaCl}_2 + \text{H}_2\text{SO}_4$ \downarrow $\text{BaSO}_4 + 2\text{HCl}$ $\text{HCl} + \text{NH}_4\text{OH}$ \downarrow $\text{NH}_4\text{Cl} + \text{H}_2\text{O}$	A colourless and pungent smelling gas is evolved (HCl). The gas when exposed to a glass rod dipped in NH_4OH forms white dense fumes.

(Continued)

Anion	Test	Reactions involved	Observation and Inference
Nitrate (NO_3^-)	Action of conc. H_2SO_4 in the presence of copper turnings	$4\text{NaNO}_3 + 2\text{H}_2\text{SO}_4 + \text{Cu} \rightarrow$ \downarrow $2\text{Na}_2\text{SO}_4 + 2\text{NO}_2 + \text{Cu}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$	A reddish brown pungent gas is evolved (NO_2) and the solution turns blue. ($\text{Cu}(\text{NO}_3)_2$)

○ **Confirmatory tests for anions**

Anion	Test	Reaction Involved	Observation
Carbonate (CO_3^{2-})	Reaction with BaCl_2 solution	$\text{CaCO}_3 + \text{BaCl}_2 \rightarrow$ \downarrow $\text{BaCO}_3 \downarrow + \text{CaCl}_2$	A white precipitate (BaCO_3) which is soluble in conc. HCl
Chloride (Cl^-)	Reaction with AgNO_3 solution	$2\text{BaCl}_2 + 2\text{AgNO}_3 \rightarrow$ \downarrow $2\text{AgCl} \downarrow + \text{Ba}(\text{NO}_3)_2$	White curdy precipitate (AgCl)
Nitrate (NO_3^-)	Brown ring test: Salt solution + freshly prepared ferrous sulphate solution + conc. H_2SO_4	$\text{NaNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{HNO}_3$ $6\text{FeSO}_4 + 3\text{H}_2\text{SO}_4 + 2\text{HNO}_3 \rightarrow$ $3\text{Fe}_2(\text{SO}_4)_3 + 4\text{H}_2\text{O} + 2\text{NO}$ $\text{FeSO}_4 + \text{NO} \rightarrow [\text{Fe}(\text{NO})]\text{SO}_4$ (brown ring)	A reddish brown ring (nitroso ferrous sulphate) is formed at the junction of the two layers
Sulphate (SO_4^{2-})	Reaction with BaCl_2 solution	$\text{ZnSO}_4 + \text{BaCl}_2 \rightarrow \text{ZnCl}_2 + \text{BaSO}_4 \downarrow$ <div style="text-align: right;">White</div>	A white precipitate (BaSO_4) which is insoluble in conc. HCl

○ **Table showing different characteristic precipitations given by different metal ions**

Salt Solution and its colour	Cation of salt	Precipitate formed	
		NaOH	NH_4OH
FeSO_4 (Green)	Fe^{+2}	$\text{Fe}(\text{OH})_2$ Dirty green Insoluble in excess NaOH	$\text{Fe}(\text{OH})_2$ Dirty green Insoluble in excess NH_4OH
FeCl_3 (Brown)	Fe^{+3}	$\text{Fe}(\text{OH})_3$ Reddish brown Insoluble in excess NaOH	$\text{Fe}(\text{OH})_3$ Reddish brown Insoluble in excess NH_4OH
CaCl_2 (Colourless)	Ca^{+2}	$\text{Ca}(\text{OH})_2$ Milky white Insoluble in excess NaOH	No reaction — —
ZnSO_4 (Colourless)	Zn^{+2}	$\text{Zn}(\text{OH})_2$ White Soluble in excess NaOH (colourless solution)	$\text{Zn}(\text{OH})_2$ White Soluble in excess NH_4OH (colourless solution)
$\text{Pb}(\text{NO}_3)_2$ (Colourless)	Pb^{+2}	$\text{Pb}(\text{OH})_2$ Chalky white Soluble in excess NaOH	$\text{Pb}(\text{OH})_2$ Chalky white Insoluble in excess NH_4OH

(Continued)

Salt Solution and its colour	Cation of salt	Precipitate formed	
		NaOH	NH ₄ OH
CuSO ₄ (Blue)	Cu ⁺²	Cu(OH) ₂ Pale blue Insoluble in excess NaOH	Cu(OH) ₂ Pale blue Soluble in excess NH ₄ OH (deep blue solution)
Mg(NO ₃) ₂ (Colourless)	Mg ⁺²	Mg(OH) ₂ Milky white Insoluble in excess NaOH	No reaction

Solved Examples

1. Acetic acid is a weak acid whereas HCl is a strong acid. Give reasons.

☞ **Solution:** If the same concentration of acetic acid and hydrochloric acid are taken, acetic acid furnishes less number of H⁺ ions in its aqueous solution than that of HCl. Hence, acetic acid is a weak acid whereas HCl is a strong acid in aqueous solution.

2. How is the degree of ionization related to strength of an acid? Explain.

☞ **Solution:** Acids undergo ionization in aqueous solution. The degree of ionization of an acid in an aqueous solution is called the strength of that acid. Degree of ionization is denoted by the letter alpha (α).

$$\alpha = \frac{\text{Number of ionised acid molecules}}{\text{Total number of acid molecules}} \times 100$$

On the basis of the degree of ionization, the acids are classified as

- strong acids (high degree of dissociation)
- weak acids (low degree of dissociation).

3. How does the concentration of hydronium ions change during dilution of an acid?

☞ **Solution:** Dilution of an acid decreases the concentration of hydronium ions per unit volume.

4. Give reasons for the following.

- Metal oxides generally react with acids. But zinc oxide reacts even with sodium hydroxide.
- Heat of neutralization value for the reaction of HCl and NH₄OH is less than 13.7 kcal/mole
- All indicators are not suitable for all titrations.

☞ **Solution:** (a) Zinc oxide is amphoteric in nature. Hence, it can react both with acids as well as bases.

(b) NH₄OH is a weak base and hence some heat is utilized to ionize the weak base.

(c) Indicator which undergoes colour change in the pH range of the titration is only suitable for a particular titration.

5. What is the pH value of 0.05 M H₂SO₄ solution?

☞ **Solution:** [H⁺] = 0.05 × 2 = 0.10
pH = - log (0.05 × 2) = 1

6. Explain the action of phenolphthalein indicator in the titration of acetic acid versus sodium hydroxide.

☞ **Solution:** Acetic acid is a weak acid having a pH value of more than 6. Sodium hydroxide is a strong base and addition of OH⁻ ions neutralizes the H⁺ ions formed by the dissociation of acetic acid. Since H⁺ ion concentration is very

low, the addition of further OH^- ions increases the pH value abruptly. Therefore, the titration range of this reaction lies between 6.5 to 10.0. The pH range of phenolphthalein is 8.2 to 10.0 and hence it undergoes colour change in this range. Hence it acts as a suitable indicator for this titration.

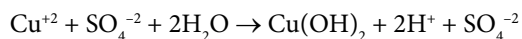
7. Is a solution with pH 6 acidic, basic or neutral? Justify.

👉 **Solution:** A solution with pH 6 will be acidic when the ionic product of water is $1 \times 10^{-14} \text{ mole}^2/\text{litre}^2$. In such a case, a solution with pH less than 7 is acidic in nature. On increasing the temperature, the ionic product of water increases due to increase in the ionization of water. When the ionic product of water increases to $1 \times 10^{-12} \text{ mole}^2/\text{litre}^2$, a solution with pH 6 will be neutral and below 6 will be acidic in nature.

8. Define salt hydrolysis. Explain the nature of aqueous solution of CuSO_4 on the basis of the above phenomenon.

👉 **Solution:** The phenomenon in which a simple salt on dissolution in water forms a parent acid and a parent alkali resulting in acidic, basic or neutral solution is called salt hydrolysis. It is the most important property of salts.

CuSO_4 on hydrolysis produces a strong acid which ionizes and a weak base which does not ionize. This increases the concentration of H^+ ions making the solution acidic with $\text{pH} < 7$ (at 25°C)



As cation of the salt reacts with water, it is called cationic hydrolysis.

9. How do you identify the following cations in their aqueous solutions by using caustic soda solution?

(a) Fe^{+2} (b) Zn^{+2} (c) Al^{+3}

👉 **Solution:** (a) Fe^{+2} gives light green precipitate of ferrous hydroxide ($\text{Fe}(\text{OH})_2$)

(b) Zn^{+2} gives white precipitate of zinc hydroxide ($\text{Zn}(\text{OH})_2$)

(c) Al^{+3} gives white gelatinous precipitate of aluminium hydroxide ($\text{Al}(\text{OH})_3$).

10. What is the use of an indicator in titration? Name the indicator used when sodium hydroxide is titrated against sulphuric acid.

👉 **Solution:** The neutralization point can be determined by the use of indicator. The indicator used when sodium hydroxide is titrated against sulphuric acid is phenolphthalein.

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- Acetic acid contains four hydrogen atoms. So its basicity is _____.
 (1) 1 (2) 2
 (3) 3 (4) 4
- According to Lewis theory, neutralization is the
 (1) transfer of proton from acid to base.
 (2) transfer of proton from base to acid.
 (3) transfer of electron pair from acid to base.
 (4) transfer of electron pair from base to acid.
- The basicity of acetic acid is the same as the basicity of _____.
 (1) HNO_3 (2) H_2SO_4
 (3) H_3PO_4 (4) H_2CO_3
- Neutralization reaction among the following is
 (1) $\text{Na}_2\text{O} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3$
 (2) $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Cl}^-$
 (3) $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$
 (4) All the above
- Which among the following statements is false?
 (1) Every protonic acid has its conjugate acid.
 (2) Pair of Bronsted acid and base that differ by a proton is conjugate acid base pair.
 (3) A substance that accepts an electron pair to form coordinate covalent bond is an acid.
 (4) Arrhenius theory is confined to aqueous solutions.
- Identify the acidic salt among the following.
 (1) Na_2SO_4 (2) NaHSO_4
 (3) $\text{Cu}(\text{OH})\text{NO}_3$ (4) CaOCl_2
- $\text{X} + \text{H}_2\text{O} \rightarrow \text{Y}$. Y is used to remove grease stains from woollen clothes. Identify X and Y.
 (1) $\text{NH}_3, \text{NH}_4\text{Cl}$
 (2) $\text{NH}_3, \text{NH}_4\text{OH}$
 (3) $\text{NH}_4\text{OH}, \text{NH}_3$
 (4) Cl_2, HCl
- Sting of a honey bee causes pain and burning sensation because it contains
 (1) formic acid. (2) oxalic acid.
 (3) acetic acid. (4) tartaric acid.
- According to which theory/theories ammonia is a base?
 (1) Arrhenious, Bronsted
 (2) Bronsted, Lewis
 (3) Arrheniouns, Lewis
 (4) Both (2) and (3)
- Arrange HClO_3 , HBrO_3 and HIO_3 in the order of acidic strength.
 (1) $\text{HClO}_3 > \text{HBrO}_3 > \text{HIO}_3$
 (2) $\text{HBrO}_3 > \text{HIO}_3 > \text{HClO}_3$
 (3) $\text{HIO}_3 > \text{HBrO}_3 > \text{HClO}_3$
 (4) $\text{HClO}_3 > \text{HIO}_3 > \text{HBrO}_3$
- Identify the strongest acid among the following.
 (1) HOCl (2) HClO_2
 (3) HClO_3 (4) HClO_4
- Which of the following solutions has the same concentration of H^+ ions as 0.1 N HCl ?
 (1) 0.05 M H_2SO_4 (2) 0.3 M H_3PO_4
 (3) 0.2 M HNO_3 (4) All the above
- The indicator which shows colour change in the entire pH range is
 (1) phenolphthalein (2) methyl orange
 (3) universal indicator (4) thymol blue
- Heat of neutralization is less than 13.7 kcal/mole for which of the following reactions?
 (1) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 (2) $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
 (3) $\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$
 (4) $\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$
- The basicity of phosphorous acid is the same as the basicity of _____.
 (1) HNO_3 (2) H_2SO_4
 (3) H_3PO_4 (4) HCl
- V_1 ml of x molar hydrochloric acid is mixed with V_2 ml of y molar sodium hydroxide. Arrange the following steps in correct sequence for calculation of pH of the mixture. ($y > x$ and $V_1 > V_2$)
 (a) Calculation of the number of equivalents of acid and base.
 (b) Calculation of the total volume of mixture.

- (c) Calculation of the normality of acid and base.
 (d) Calculation of the net OH^- ion concentration.
 (e) Taking the negative logarithm of H^+ ion concentration.
 (f) Dividing K_w by OH^- ion concentration
 (1) a c b f d e (2) c a b d f e
 (3) c a b f d e (4) a b c d f e
17. From the pH values given below, write the decreasing order of hydronium or H^+ ion concentration. 13, 11, 9.
 (1) 13, 11, 9 (2) 9, 11, 13
 (3) 9, 13, 11 (4) 11, 13, 9
18. Equivalent mass of 'X' is equal to the molecular mass. Identify X.
 (1) CH_3COOH (2) H_2SO_4
 (3) H_3PO_4 (4) H_2CO_3
19. Calculate the equivalent mass of HCl.
 (1) 31 (2) 35.5
 (3) 36.5 (4) 18.2
20. 14.3 g of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ is dissolved in water and the volume is made up to 200 ml. 20 ml of this solution required 40 ml of $\frac{N}{4}$ HNO_3 for complete neutralization. Calculate x.
 (1) 3 (2) 4
 (3) 9 (4) 10
21. How many moles of NaOH must be added to 200 ml of 0.1 M solution of HNO_3 to get a solution having pH value 2? (considering NaOH in solid state)
 (1) 0.08 (2) 0.018
 (3) 0.011 (4) 0.01
22. 8 g of mixture of NaNO_3 and Na_2CO_3 are dissolved and made into 500 ml of solution. 50 ml of this solution neutralizes completely 25 ml of N/5 HNO_3 . Calculate the mass of Na_2CO_3 present in the mixture
 (1) 2.65 g (2) 5.35 g
 (3) 8 g (4) 4.15 g
23. What kind of salt is NaHSO_3 ?
 (1) Acidic salt (2) Basic salt
 (3) Normal salt (4) Double salt
24. Three cations A, B, C are allowed to react with ammonium hydroxide solution. A and B produce a dirty green precipitate and a reddish brown precipitate respectively, both of which do not dissolve on further addition of NH_4OH . C gives pale blue colour precipitate with less amount of ammonium hydroxide and on further addition of NH_4OH , precipitate becomes soluble and deep blue colour solution is formed.
 (1) Fe^{+2} , Fe^{+3} , Cu^{+2} (2) Fe^{+3} , Fe^{+2} , Cu^{+2}
 (3) Cu^{+2} , Fe^{+2} , Fe^{+3} (4) Cu^{+2} , Fe^{+3} , Fe^{+2}
25. Two salts A and B are dissolved in water separately. When phenolphthalein is added to the two solutions, one solution turned pink and the other solution was colourless. Identify A and B.
 (1) CH_3COONa , NH_4Cl
 (2) Na_2SO_4 , CH_3COONa
 (3) NH_4Cl , Na_2SO_4
 (4) NaNO_3 , Na_2SO_4
26. What could be the nature of aqueous solution of sodium sulphate?
 (1) Acidic
 (2) Basic
 (3) Neutral
 (4) Nature depends on the concentration of the solution.
27. Calculate the resultant pH of a solution when 20 ml of 0.1 N NaOH is mixed with 20 ml of 0.05 M $\text{Ca}(\text{OH})_2$ at 25°C .
 (1) 1 (2) 2
 (3) 13 (4) 14
28. 100 ml of Na_2CO_3 solution containing 5.3 g of Na_2CO_3 was exactly neutralized by 200 ml of H_2SO_4 solution. What is the pH of H_2SO_4 ? ($\log 5 = 0.6990$)
 (1) 0.5 (2) 1
 (3) 0.6990 (4) 0.3010
29. The ionic product of water is found to be 1×10^{-12} mole²/ℓ² at 60°C . What would be the nature of solution with pH = 7?
 (1) Basic
 (2) Acidic
 (3) Neutral
 (4) Cannot be determined
30. Two coloured salt solutions of two metals A and B gave precipitates with NaOH and NH_4OH . The oxidation states of salts of metal A and B are same. On further addition of NH_4OH , the precipitate disappears, in the case of B. There is no such change in the case of 'A' either with NaOH or NH_4OH . Identify A and B. Give necessary equations.

- (1) $\text{Fe}^{+2}, \text{Cu}^{+2}$ (2) $\text{Cu}^{+2}, \text{Fe}^{+2}$
 (3) $\text{Fe}^{+}, \text{Fe}^{+3}$ (4) $\text{Fe}^{+3}, \text{Cu}^{+2}$
31. Calculate the weight of nitric acid present in 40 ml of solution which completely neutralizes 20 ml of 0.01 M barium hydroxide assuming complete ionization.
 (1) 0.40 g
 (2) 0.0004 g
 (3) 0.0252 g
 (4) 0.063 g
32. Find the pH of resultant solution when 100 ml of 0.005 M H_2SO_4 at 25°C is diluted to 1000 ml. What is the amount of NaOH required to be dissolved in 500 ml to exactly neutralize the above solution?
 (1) 4 g (2) 4×10^{-2} g
 (3) 40 g (4) 0.4 g
33. Which of the following cannot act as an acid as well as a base according to protonic concept?
 (1) HSO_4^- (2) H_2O
 (3) HS^- (4) ClO_4^-
34. Predict the type of salts formed by the reaction between H_2SO_4 and $\text{Ca}(\text{OH})_2$
 (1) Normal salt (2) Acidic salt
 (3) Basic salt (4) Both (1) and (2)
35. Calculate the equivalent mass of H_2SO_4 from the given reactions.
 (a) $\text{H}_2\text{SO}_4 + \text{NaOH} \rightarrow \text{NaHSO}_4 + \text{H}_2\text{O}$
 (b) $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
 (1) 49 and 98 (2) 98 and 49
 (3) Both 49 (4) Both 98

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Identify the species which can give both conjugate acid and conjugate base.
 (1) NH_4^+ (2) H_2PO_4^-
 (3) PO_4^{3-} (4) H_3O^+
2. Which of the following is not a base according to any of the theories?
 (1) $\text{Mg}(\text{OH})_2$ (2) NH_3
 (3) H_2PO_4^- (4) BF_3
3. Which of the following species cannot have conjugate base?
 (1) HSO_4^- (2) HPO_4^{2-}
 (3) PO_4^{3-} (4) H_2PO_2^-
4. Which among the following pairs of acid and base are weak respectively?
 (1) HCOOH and NH_4OH
 (2) HCl and NaOH
 (3) CH_3COOH and KOH
 (4) HClO_4 and CsOH
5. What are the basicities H_3PO_4 and H_3PO_3 respectively?
 (1) 2, 3 (2) 1, 2
 (3) 3, 3 (4) 3, 2
6. Which of the following has the highest value of pH at the same temperature for the same concentration?
 (1) HCl (2) NaOH
 (3) $\text{Ca}(\text{OH})_2$ (4) CH_3COOH
7. The pH of 0.001 N sodium hydroxide solution at 25°C is
 (1) 3 (2) 4
 (3) 11 (4) 12
8. Which of the following pH values at 25°C corresponds to the strongest acid?
 (1) 2 (2) 4
 (3) 6 (4) 8
9. A solution turns methyl orange red. It can turn the universal indicator to _____
 (1) violet (2) blue
 (3) orange (4) green
10. A strongly acidic solution is taken and a base is slowly added to it drop by drop. Arrange the colours observed during the process of addition in proper sequence.
 (a) Green (b) Indigo
 (c) Orange (d) Red
 (e) Blue (f) Violet
 (g) Yellow

- (1) c d a g b e f
 (2) d c g a e b f
 (3) d c a g e b f
 (4) c d g a f b e
11. What is the pH of 0.001 M HCl?
 (1) 1 (2) 2
 (3) 3 (4) 4
12. If two strong acids A, B having pH of 1 and 2 of same volume respectively are mixed, then what is the pH range of the new solution?
 (1) Less than 1
 (2) Greater than 2
 (3) Between 1 and 2
 (4) Can't be calculated
13. A solution of which of the following pH turns universal indication violet?
 (1) pH = 1 (2) pH = 9
 (3) pH = 5 (4) pH = 13
14. 10 ml of 1 N HCl, 25 ml of 2 N H_2SO_4 and 40 ml of X N HNO_3 are mixed and made up to 2000 ml. 100 ml of this solution required 30 ml of NaOH taken from a solution containing 4 g of NaOH in 250 ml of solution. What is the value of X?
 (1) 2.5 N (2) 3.5 N
 (3) 4.5 N (4) 5.5 N
15. The ionic product of water calculated by a student was found to be $1 \times 10^{-16} \text{ mole}^2/\ell^2$ at 5°C . What is the nature of solution with pH = 7 at same temperature?
 (1) Basic
 (2) Acidic
 (3) Neutral
 (4) Cannot be predicted.
16. The nature of resultant solution when 20 ml of 0.05 M NaOH is mixed with 10 ml of 0.1 N HCl solution at 25°C is
 (1) acidic
 (2) basic
 (3) neutral
 (4) Can't be predicted
17. No indicator can be used for the titration between formic acid and ammonium hydroxide because
 (1) formic acid is weak acid and ammonium hydroxide is weak base
 (2) formic acid is weak acid and ammonium hydroxide is strong base
 (3) formic acid is strong acid and ammonium hydroxide is weak base
 (4) formic acid is strong acid and ammonium hydroxide is strong base
18. A solution of which among the following salts is basic in nature?
 (1) MgSO_4 (2) NaNO_3
 (3) CH_3COONa (4) NaCl
19. (a) Potash alum responds to the test for two cations and one negative radical
 (b) Bleaching powder responds the test for two cations and one negative radical.
 (c) Disodium potassium phosphate responds the test for three cations and one negative radical.
 (d) Sodium argento cyanide responds the test for one cation and one negative radical.
 Which of the following option regarding the above statements is correct?
 (1) a and d (2) b and c
 (3) only d (4) a, c and d
20. An aqueous solution of carnallite salt can give a precipitate with silver nitrate but the aqueous solution of $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ cannot give a precipitate with silver nitrate. How do you account for this?
 (1) Both salts are double salts
 (2) Both salts are complex salts
 (3) First one is a double salt and other one is a complex salt
 (4) First one is a complex salt and other one is a double salt
21. Both ammonium oxalate and potassium sulphate give neutral solutions in water. But, it is said that ammonium oxalate undergoes hydrolysis and potassium sulphate does not undergo hydrolysis. Because ammonium oxalate is a salt of ____ acid ____ base
 (1) weak, weak (2) weak, strong
 (3) strong, strong (4) strong, weak
22. An aqueous solution of Mohr's salt can give a precipitate with NaOH or NH_4OH . But, the aqueous solution of potassium ferrocyanide cannot give a precipitate with both reagents. How do you account for this?
 (1) Both salts are double salts
 (2) Both salts are complex salts
 (3) First one is a double salt and other one is a complex salt
 (4) First one is a complex salt and other one is a double salt

23. Find the pH of 0.005 M $\text{Ba}(\text{OH})_2$ solution at 25°C . Also calculate the pH value of the solution when 100 ml of the above solution is diluted to 1000 ml. (Assume complete ionization of barium hydroxide)
- (1) 8, 9 (2) 2, 3
(3) 10, 12 (4) 12, 11
24. What are the spectator ions in the reaction of potassium hydroxide with sulphuric acid?
- (1) $\text{H}^{+1}, \text{OH}^{-1}$ (2) $\text{H}^{+1}, \text{SO}_4^{-2}$
(3) $\text{K}^{+1}, \text{OH}^{-1}$ (4) $\text{K}^{+1}, \text{SO}_4^{-2}$
25. Calculate the pH of resultant solution at 25°C when 10 ml of 0.04 M H_2SO_4 is diluted 1000 times and 100 ml of the diluted acid is mixed with 100 ml of 0.001 M NaOH solution at 25°C .
- (1) 8.2 (2) 9.5
(3) 10.7 (4) 12.8
26. Give pH range of acidic, neutral and basic solutions at 25°C .
- (1) $<7, 7, >7$
(2) $<8, 9, >10$
(3) $<6, 7, >7$
(4) $<5, 6, >7$
27. 10 ml of 0.01 N NaOH is diluted to 1000 ml. What should be the amount of sodium hydroxide required to be added in order to maintain the concentration of the solution as that of the earlier solution.
- (1) 0.396 g
(2) 0.450 g
(3) 0.275 g
(4) 0.470 g
28. The acids present in tamarind and vinegar ____ and respectively.
- (1) oxalic acid, acetic acid
(2) oxalic acid, tartaric acid
(3) tartaric acid, oxalic acid
(4) tartaric acid, acetic acid
29. Calculate the normality of a solution of sulphuric acid containing 0.49 g of substance in 250 ml solution.
- (1) 0.01 N (2) 0.02 N
(3) 0.04 N (4) 0.06 N
30. Calculate the pH value of 0.01 M H_2SO_4 solution. ($\log 2 = 0.3010$)
- (1) 0.45 (2) 0.55
(3) 0.64 (4) 0.699
31. Assume that product of water is 12 at 50°C . Some statements related to the given statement are listed below.
- (a) Addition of an acid at the given temperature to water increases the ionic product of water because of increase in H^{+} ions.
(b) Addition of base to water decreases the ratio of H^{+} to OH^{-} .
(c) Addition of an acid on a base suppresses the dissociation of water molecules.
(d) Ionic product of water varies only with temperature.
- Which of the following option is correct?
- (1) a, b and c
(2) b, c and d
(3) c and d
(4) a and b
32. (a) Incomplete neutralization of sodium hydroxide with sulphuric acid gives rise to a basic salt.
(b) Incomplete neutralization of aluminum hydroxide with sulphuric acid can give rise to an acidic salt and two basic salts.
(c) Incomplete neutralization of calcium hydroxide with sulphuric acid can give rise to an acidic and a basic salt.
(d) Incomplete neutralization of cupric hydroxide with nitric acid gives rise to a basic salt.
- Regarding the above statements, which of the following options is correct?
- (1) only b
(2) only d
(3) a and b
(4) c and d
33. Identify dirty green precipitate among the following.
- (1) $\text{Fe}(\text{OH})_2$
(2) $\text{Pb}(\text{OH})_2$
(3) $\text{Mg}(\text{OH})_2$
(4) $\text{Zn}(\text{OH})_2$
34. 200 ml of 0.2 N sodium carbonate solution is diluted by adding 800 ml of water. Calculate the normality of diluted solution.
- (1) 0.04 (2) 0.4
(3) 0.1 (4) 0.01
35. Calculate the pH value of HNO_3 solution containing 0.315 g acid in 200 ml of solution. ($\log 2.5 = 0.3979$)
- (1) 1.6021 (2) 2
(3) 0.3979 (4) 1

ANSWER KEYS

PRACTICE EXERCISE 7 (A)

1. 1	2. 4	3. 1	4. 4	5. 1	6. 2	7. 2	8. 1	9. 2	10. 1
11. 4	12. 1	13. 3	14. 4	15. 2	16. 2	17. 2	18. 1	19. 3	20. 4
21. 2	22. 1	23. 1	24. 1	25. 1	26. 3	27. 3	28. 4	29. 1	30. 1
31. 3	32. 2	33. 4	34. 2	35. 2					

PRACTICE EXERCISE 7 (B)

1. 2	2. 4	3. 3	4. 1	5. 4	6. 2	7. 3	8. 1	9. 3	10. 2
11. 3	12. 3	13. 4	14. 3	15. 2	16. 3	17. 1	18. 3	19. 1	20. 3
21. 2	22. 3	23. 4	24. 4	25. 3	26. 1	27. 1	28. 4	29. 3	30. 4
31. 2	32. 2	33. 1	34. 1	35. 1					

Metallurgy and Industrial Chemistry

SYNOPSIS

- Metallurgy is the branch of science which deals with the extraction of metals from the ores and transformation of the metals into various usable forms. It also help us understand their physical and chemical properties.
- Metals react with oxygen to form either basic or amphoteric oxides and non-metals react with oxygen to form either acidic or neutral oxides.
- Metals are extracted from suitable ores through certain general metallurgical processes like dressing, concentration, conversion of ore to oxide, extraction of metal and finally refining.
- Active metals such as sodium, potassium, magnesium and aluminium cannot be extracted either by using reducing agents or by electrolysis of their aqueous solutions. They are obtained by subjecting their molten salts to electrolysis.
- Froth flotation process is mainly used to concentrate sulphide ores whereas gravity separation process is used to concentrate the ores which do not contain sulphide.
- Coke, aluminium powder and carbon monoxides are used to reduce the metal oxides like ZnO , Cr_2O_3 and Fe_2O_3 respectively.
- Sodium hydroxide and sodium carbonate are used in the purification of bauxite containing ferric oxide as the impurity.
- Refining of metals is done by different processes based on the nature of metal, for example, zinc, copper and aluminium by distillation, polling and electrolytic refining respectively.
- In electrolytic reduction of alumina, cryolite and fluorspar are added to alumina to decrease the melting point and increase the electrical conductivity. The discharge of Al^{+3} and O^{-2} ions at the respective electrodes is attributed to their discharge potentials.
- Among the different forms of iron, wrought iron is the purest form hence it has more malleability. The malleability of iron decreases with increase in carbon content.
- Tinning is not as effective as galvanization for protecting iron from rusting. This is related to the electrode potentials of tin and zinc with respect to iron.
- Alloys possess desired properties compared to the properties of their constituents. Hence alloys have varied applications in modern life.
- Nitric acid can be stored in the container made up of aluminium as it remains passive towards nitric acid.
- The mixture of aluminium powder and ammonium nitrate is known as ammonal which is used as an explosive.
- Zinc is a electropositive metal and hence is used as a cathode in dry cells.
- Active metals like Al, Zn and Fe react with dilute and concentrated HCl to liberate hydrogen gas.

- Certain metals like Fe, Sn expand on solidification.
- Diamond and graphite are crystalline forms of carbon. Diamond has a compact three dimensional crystalline structure while graphite has a layered structure having hexagonal rings arranged parallel to each other.
- Diamond is a good conductor of heat while graphite is a good conductor of electricity. Also, Diamond is the hardest substance while graphite is used as a solid lubricant.
- Conductivity of graphite is due the presence of free electrons present in it.
- Nitrogen is chemically inactive element present in air which dilutes the activity of oxygen.
- Among the amorphous forms of carbon, wood charcoal, sugar charcoal and animal charcoal show good adsorbent properties.
- Among the two oxides of carbon, carbon dioxide is a greenhouse gas and increase in the level of CO_2 leads to global warming.
- Non-metals do not usually react with acids but react with nitric acid and form their respective non-metallic oxides.
- Among the two allotropes of phosphorus white phosphorus is more reactive than red phosphorus. Compounds of white phosphorus are poisonous in nature.
- H_2S contributes to air pollution. It acts as a reducing agent and it converts metallic salts into corresponding sulphides.
- Chlorine is greenish yellow gas which readily reacts with water in the presence of sun light to form HCl and HClO . HClO decomposes to give nascent oxygen.
- Among all the fuels, hydrogen has the highest calorific value.
- Diamond and graphite exhibit characteristic properties due to the presence of closely packed tetrahedral and hexagonal layers in their structures respectively.
- Ignition temperature and reactivity of allotropic forms of phosphorus depend upon the arrangement of P_4 tetrahedral units.
- SO_2 bleaches by the process of reduction while Cl_2 bleaches by the process of oxidation.
- Hydrogen sulphide is a good analytical or laboratory reagent.
- Sulphuric acid is prepared by contact process by applying suitable experimental conditions like pressure, temperature and catalyst.
- Chemical reactivity of lime with CO_2 is exploited in the usage of lime as white washing substance.
- The quality of bleaching powder depends up on available chlorine.
- Addition of different ingredients in a small quantity to glass during its manufacture imparts different properties to the glass like resistance to heat, high refractive index, variety of colours etc depending on the nature of dopants.
- Ceramics are highly thermal and chemical resistant.
- Different fertilisers have their own advantages depending up on their composition, nature of the soil and time taken for assimilation by plants.
- Glass is a supercooled liquid. The process of cooling molten glass i.e., annealing makes the glass transparent. The quality of glass depends on the process of cooling.

Solved Examples

1. Extraction of metals always involves reduction processes. Explain.

☞ **Solution:** Metals are always available in nature in the form of ores, in which the metal remains as cation. Extraction of the metal from the ore is to get the metal in its elemental state. For this purpose, any metal compound always needs to be reduced.

2. Green wooden poles are used during the process of refining of copper. What purpose do they serve?

☞ **Solution:** Wooden poles are used to agitate molten impure copper. The heat of the molten metal decomposes green wooden poles and methane gas is emitted from the poles. This methane reduces cuprous oxide to copper.

3. Reduction of alumina which is obtained, either by Hall's process or Bayer's process to aluminium metal is carried out by electrolysis. During this process, cryolite and fluorspar are added to alumina, the entire mixture is covered with coke powder. Why cannot alumina be directly electrolyzed?

☞ **Solution:** Alumina cannot be directly electrolysed because alumina has high thermal stability and hence very high temperature is required for melting pure alumina.

Cryolite and fluorspar are added to alumina in order to decrease the melting point of alumina and increase the electrical conductivity of the mixture.

4. In L-D converter pure oxygen is used for oxidation while in Bessemer process air is used for the same purpose. Which of these is better and why?

☞ **Solution:** Usage of oxygen is better because of the following reasons.

- (i) Nitrogen in air makes the steel brittle.
- (ii) Nitrogen carries away a lot of heat and hence attaining the required temperature is tedious.

5. Wrought iron is more malleable than cast iron. Give reason.

☞ **Solution:** Wrought iron is the purest form of iron. Its carbon content is the least. Hence it is highly malleable.

6. What is meant by blister copper? What is the reason for the formation of blister copper?

☞ **Solution:** Copper obtained from Bessemer converter by the process of Bessemerization gets blister type appearance. This is called blister copper. During the process of Bessemerization, Cu_2O and Cu_2S react to produce copper and SO_2 gas. In this process, copper is obtained in the molten form and then it is solidified. During solidification, SO_2 gas escapes and hence blister copper is obtained.

7. In the preparation of ammonia gas from ammonium chloride and calcium hydroxide, the reactants are ground thoroughly. Why?

☞ **Solution:** It increases the surface area of the reactants which helps in speeding up the reaction.

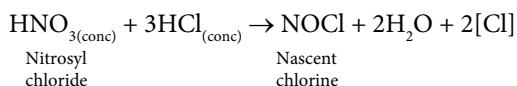
8. The yellowish tinge of nitric acid can be removed by the dropwise addition of water to it. Give reasons.

☞ **Solution:** By the addition of water drop by drop to nitric acid, nitrogen dioxide present in it gets converted to nitric acid. Since the yellow tinge is due to NO_2 , HNO_3 becomes almost colourless by this process.

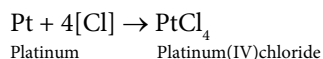
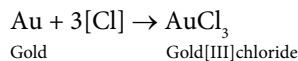
9. Gold and platinum do not dissolve either in conc HCl or conc HNO_3 , but dissolves in the mixture of 3 parts of conc HCl and 1 part of conc HNO_3 . Give reason and write the necessary chemical equations.

☞ **Solution:** The dissolution of noble metals in aquaregia can be justified as follows.

(i) The concentrated nitric acid oxidizes concentrated hydrochloric acid to liberate nascent chlorine.

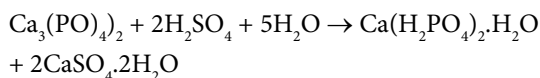


(ii) Nascent chlorine reacts with noble metals to form their soluble chlorides which pass into the solution.



10. How is superphosphate of lime manufactured?

☞ **Solution:** Superphosphate of lime can be prepared by the treatment of powdered phosphate rock with conc H_2SO_4 . The mass obtained is hard due to the presence of gypsum.



PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- Non-metal which can form both neutral and acidic oxides is _____.
 (1) sulphur (2) nitrogen
 (3) chlorine (4) phosphorus
- Which among the following is an oxide ore of lead?
 (1) Lead ochre (2) Galena
 (3) Anglesite (4) Dolomite
- $X + \text{CuSO}_4 \rightarrow \text{XSO}_4 + \text{Cu}$, $Y + \text{CuSO}_4 \rightarrow \text{YSO}_4 + \text{Cu}$, in these reactions X and Y may be _____.
 (1) Zn, Ag (2) Zn, Fe
 (3) Fe, Ag (4) Ag, Al
- Which of the following metals forms amphoteric oxide when it reacts with oxygen?
 (1) Sodium (2) Magnesium
 (3) Aluminium (4) Potassium
- Processes involved in the dressing of an ore are
 (i) grinding and crushing
 (ii) hand picking
 (iii) pulverization
 They follow the order
 (1) (i), (ii), (iii) (2) (i), (iii), (ii)
 (3) (ii), (iii), (i) (4) (ii), (i), (iii)
- The composition of thermite mixture is
 (1) iron (III) oxide and aluminium powder in the ratio 1 : 3.
 (2) aluminium powder and iron (III) oxide in the ratio 1 : 3.
 (3) aluminium powder and barium peroxide in the ratio 1 : 3.
 (4) barium peroxide and aluminium powder in the ratio 1 : 3
- Select the steps required for the extraction of aluminium and sequence them.
 (a) Froth flotation
 (b) Chemical separation
 (c) Electrolytic reduction
 (d) Smelting
 (e) Distillation under low pressure

- Electrolytic refining
 (g) Pulverization
 (h) Conversion of concentrated ore into oxide
 (i) Crushing and grinding.
 (1) i e g b c h f a
 (2) c b a d e f g h
 (3) i g b h c f
 (4) i g b c h f
- Identify the metal which reacts with concentrated H_2SO_4 or HNO_3 , but not with concentrated HCl.
 (1) Fe (2) Zn
 (3) Cu (4) Al
- Aluminium liberates hydrogen gas on reaction with
 (1) concentrated sulphuric acid.
 (2) nitric acid.
 (3) hydrochloric acid.
 (4) None of the above
- In the extraction of iron, the most preferred ores are
 (1) hematite and limonite.
 (2) copper pyrites and siderite.
 (3) magnetite and iron pyrites.
 (4) limonite and copper pyrites.
- Which among the following metal is not present in german silver?
 (1) Cu (2) Ag
 (3) Zn (4) Ni
- The reactions given below represent the processes of reduction to obtain metals from their respective ores. Arrange them in the following order.
 Sodium, aluminium, zinc, chromium, iron, copper and mercury
 (a) Metal oxide + metal sulphide \rightarrow Metal + SO_2
 (b) Metal oxide + CO \rightarrow Metal + CO_2
 (c) Metal oxide + C \rightarrow Metal + CO
 (d) Metal oxide \rightarrow Metal + O_2
 (e) Metal oxide $\xrightarrow{\Delta}$ Metal + O_2
 (f) Metal oxide + Aluminium \rightarrow Aluminium oxide + metal
 (g) Metal chloride \rightarrow Metal + Chlorine
 (1) g d c f b a e (2) g d c f b e a
 (3) a c b d f g e (4) g d e b f a e

13. Which of the following is true in case of CO_2 and CO ?
- Both are soluble in water and form acids.
 - Both do not dissolve in water.
 - CO dissolves in water and forms carbonic acid while CO_2 does not.
 - CO_2 dissolves in water and forms carbonic acid while CO does not.
14. Which of the following gases with a smell of rotten egg is evolved when sulphuric acid is treated with copper sulphide?
- Sulphur vapour
 - Sulphur dioxide
 - Hydrogen sulphide
 - Sulphur trioxide
15. Molar weight ratio of conc. HNO_3 and conc. HCl in aqua regia is
- 1 : 3
 - 3 : 1
 - 3 : 2
 - 2 : 3
16. Which of the following reagents is used to test the presence of SO_2 gas?
- Acidified potassium manganate
 - Alkaline potassium manganate
 - Alkaline potassium dichromate
 - Acidified potassium dichromate
17. _____ sulphur does not possess sharp melting point.
- rhombic
 - monoclinic
 - plastic
 - All the above
18. Identify the compound which is the final product of Solvay process.
- Ammonium carbonate
 - Ammonium bicarbonate
 - Sodium carbonate
 - Sodium bicarbonate
19. Which of the following reactions is called slaking of lime?
- $\text{CaCO}_3 \uparrow \rightarrow \text{CaO} + \text{CO}_2$
 - $\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$
 - $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{heat}$
 - $\text{CaCO}_3 + \text{NaCl} \rightarrow \text{Na}_2\text{CO}_3 + \text{CaCl}_2$
20. Which of the following is not an ingredient of clinker?
- Calcium silicate
 - Aluminium silicate
 - Calcium aluminium silicate
 - Gypsum
21. Which of the following imparts purple colour to glass?
- Cr_2O_3
 - AuCl_3
 - Cu_2O
 - MnO_2
22. Which among the following is a micronutrient?
- Potassium
 - Phosphorus
 - Nitrogen
 - Cobalt
23. Which of the following is an efflorescent substance?
- $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 - $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
 - $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
 - $(\text{NH}_4)_2\text{SO}_4$
24. For the manufacture of glass, various steps are given below. Arrange the steps in a proper sequence.
- Melting of raw materials
 - Adding cullet to raw materials
 - Conversion of raw material to fine powder
 - Annealing
 - Refining
- a b c d e
 - b a c e d
 - c b a e d
 - c b a e d
25. Borosilicate glasses are used as laboratory wares because of
- low thermal expansion
 - high thermal expansion
 - high refractive index
 - low refractive index
26. Dilute HCl does not react with Cu but dilute HNO_3 reacts with Cu . Give reason.
- HCl is a good oxidizing agent.
 - HCl is a weak acid.
 - HNO_3 is a good oxidizing agent.
 - HNO_3 is a strong acid.
27. The process of coating iron sheets with a thin layer of zinc is called
- galvanization
 - enamelling
 - glazing
 - alloying
28. What are the products of the following reaction?
- $$\text{CaCO}_3 \xrightarrow{\Delta}$$
- $\text{CO} + \text{CO}_2$
 - $\text{CaO} + \text{CO}$
 - $\text{CO}_2 + \text{Ca}_2\text{O}$
 - $\text{CO}_2 + \text{CaO}$

29. Which of the following methods is employed to prevent rusting?
- (1) Annealing (2) Alloying
(3) Enamelling (4) Both 2 and 3
30. Why are aluminium alloys widely used in aircraft and ships?
- (1) Due to its high melting point
(2) Due to its hardness
(3) Due to its high density
(4) Due to its light weight
31. The statements given below represent the characteristics of nitrates of different metals.
- (a) Nitrate of sodium liberates brown coloured gas on strong heating.
(b) Nitrate of calcium liberates a pair of colourless gases on strong heating.
(c) Metallic silver can be obtained from its nitrate on strong heating.
(d) Nitrate of potassium gives a solid product and a colourless gas on strong heating.
- Which of the following options is correct?
- (1) a and b (2) c and d
(3) only d (4) only b
32. The statements given below are related to different metallurgical processes.
- (a) Only sulphide ores can be concentrated by gravity separation.
(b) Zone refining is a process of concentrating ores of gallium, silicon and germanium.
(c) Copper pyrites can be concentrated by froth flotation.
(d) Polling is a process of purification where metal oxide reduces to metal.
- Which of the following is correct?
- (1) only a (2) a, b and c
(3) b, c and d (4) c and d
33. (a) Roasting and calcination are the two processes to reduce the metal oxides to the respective metals.
(b) Magnesium is extracted from its ore by electrolytic reduction process.
(c) Cryolite is used in metallurgy of aluminium in order to increase the fusibility and conductivity
(d) In Hall's process bauxite is leached with the help of Na_2CO_3 .
- Which of the following options regarding the above statements is correct?
- (1) a, b and c (2) b, c and d
(3) c and d (4) only a
34. (a) Thermite welding process exploits the difference in reactivity of different metals.
(b) Zinc spelter is used as cathode in electrolytic refining process of zinc.
(c) Iron is generally refined by electrolytic reduction process.
(d) Iron is alloyed with other metals and carbon, only to prevent corrosion.
- Which of the following options regarding the above statements is correct?
- (1) a and d (2) b and c
(3) only a (4) a, b and c
35. (a) In smelting process carried out in blast furnace for the extraction of iron, lower region of the furnace has the highest temperature.
(b) Formation of CO from CO_2 and coke reduces the temperature of the middle region of blast furnace.
(c) Limestone is taken in blast furnace as flux.
(d) Silica present in the ore as gangue is converted to fusible slag by the process of reduction.
- Which of the following regarding the process of smelting is correct?
- (1) a, b and c (2) b and c
(3) only a (4) only d

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The non-metal which cannot be oxidized to its corresponding acid by nitric acid is ____.
- (1) carbon (2) sulphur
(3) phosphorus (4) chlorine

2. Chemical separation is one of the methods employed in
- (1) dressing of ore.
(2) concentration of ore.
(3) extraction of metal from its oxide.
(4) conversion of ore to oxide.

3. Which of the following metals is soft in nature?
(1) Platinum (2) Iron
(3) Aluminium (4) Sodium
4. Which of the following is a purification method?
(1) Distillation
(2) Electrolytic process
(3) Liquation
(4) All the above
5. In the electrolytic reduction of alumina, the electrolyte is covered with coke powder because, it
(1) prevents oxidation of aluminium formed.
(2) reacts with aluminium forming aluminium carbide.
(3) prevents heat loss from the electrolyte.
(4) None of the above
6. Sequence the following steps involved generally in the extraction of a metal in pure form from its ore.
(a) The metal obtained from its oxide require further purification for end use.
(b) The ore should be converted to its oxide form.
(c) The ore is beneficial to us if it is handpicked then metal crushed and ground, and later subjected to pulverization as per the requirement.
(d) The ore in the form of oxide is required to be reduced.
(e) Dressed ore is required for it to be concentrated.
(1) e c b d a (2) c e b d a
(3) c e b a d (4) c e d b a
7. Gas liberated when zinc is treated with concentrated nitric acid is _____.
(1) nitrous oxide (2) nitric oxide
(3) nitrogen dioxide (4) nitrogen
8. The volatile impurities associated with zinc spelter are _____.
(1) Cd and Fe (2) Fe and As
(3) Cd and C (4) Cd and As
9. The reaction which is not associated with the middle region of blast furnace during smelting is _____.
(1) $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$
(2) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
(3) $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$
(4) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
10. Bell metal is an alloy of _____.
(1) Cu, Zn (2) Cu, Pb
(3) Cu, Sn (4) Cu, Ni
11. Which of the following products is/are formed by treating graphite in an atmosphere of pure oxygen?
(1) CO_2 (2) CO
(3) Fullerene (4) CO_2 , CO
12. Sugar on treating with conc. H_2SO_4 produces a black mass. In this H_2SO_4 acts as a
(1) decarboxylating agent
(2) dehydrogenating agent
(3) dehydrating agent
(4) All the above
13. Which of the following acids is produced by treating KNO_3 with H_2SO_4 under suitable experimental conditions?
(1) HNO_2 (2) H_2SO_3
(3) HNO_3 (4) $\text{H}_2\text{S}_2\text{O}_7$
14. The gases produced by thermal decomposition of nitric acid are
(1) nitric oxide and oxygen
(2) nitrous oxide and nitrogen
(3) nitrogen dioxide and oxygen
(4) nitrogen and oxygen
15. The steps for the manufacture of nitric acid by Ostwald process are given. Arrange them in sequence.
(a) Recirculation of nitric oxide
(b) Addition of H_2O to nitrogen dioxide
(c) Oxidation of nitric oxide
(d) Catalytic oxidation of ammonia
(1) d c b a (2) d c a b
(3) c d b a (4) c d a b
16. Formula of Plaster of Paris is
(1) $\text{CaSO}_4 \cdot \text{H}_2\text{O}$
(2) $3\text{CaSO}_4 \cdot \text{H}_2\text{O}$
(3) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
(4) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
17. Manufacture of which of the following does not require limestone as a raw material?
(1) Quick lime
(2) Baking soda
(3) Glass
(4) Plaster of Paris
18. The impurities collected in the process of the manufacture of glass are called _____.
(1) glass gall (2) cullet
(3) batch (4) raw meal

19. Which property is imparted to glass by the addition of cerium oxide?
- Colour
 - Resistance to breakage
 - Increase of refractive index
 - Protection from UV light
20. Which of the following fertilizers does not replenish nitrogen in the soil?
- CAN
 - Urea
 - Superphosphate lime
 - Ammonium phosphate
21. A mixture of slaked lime, sand and water is known as ____.
- lime mortar
 - concrete
 - RCC
 - clinker
22. How can the glossy, impervious nature of ceramics be obtained?
- Grouting
 - Glazing
 - Annealing
 - Softening
23. Sulphuric acid is a strong dehydrating agent. Give a chemical reaction in which the above property is exploited.
- $C_6H_{12}O_6 \rightarrow 6C + 6H_2O$
 - $H_2SO_4 \rightarrow SO_3 + H_2O$
 - $H_2SO_4 + P \rightarrow H_3PO_4 + SO_2 + H_2O$
 - $H_2SO_4 + NaOH \rightarrow NaHSO_4 + H_2O$
24. What is the gas formed when sodium chloride is heated with sulphuric acid?
- HCl
 - Cl_2
 - SO_2
 - O_2
25. A divalent metal with atomic number 12 reacts with an acid liberating a gas X. X on treatment with a non-metal Y gives Z, which on dissolution in water produces the same acid. Identify X, Y and Z.
- Cl_2, H_2, HCl
 - H_2, HCl, Cl_2
 - HCl, H_2, Cl_2
 - H_2, Cl_2, HCl
26. Copper on reaction with moist air gives ____.
- $CuSO_4, Cu(OH)_2$
 - $CuCl_2, Cu(OH)_2$
 - $CuCO_3, Cu(OH)_2$
 - $CuSO_4 \cdot 5H_2O$
27. ____ and ____ metals react with concentrated alkalis.
- Al, Mg
 - Al, Zn
 - Na, K
 - K, Al
28. Formation of rust takes place in presence of ____ and ____.
- moisture, CO_2
 - CO, H_2O
 - moisture, air
 - O_2, CO_2
29. Zinc on reaction with steam liberates ____ gas.
- Zn vapour
 - ZnO vapour
 - O_2
 - H_2
30. Solder is an alloy of ____ and ____.
- copper, tin
 - tin, lead
 - tin, zinc
 - lead, copper
31. (a) Cast iron is very hard and brittle because of higher carbon content.
 (b) Iron obtained from the blast furnace is known as pig iron.
 (c) The carbon content in wrought iron is the least.
 (d) The melting point of cast iron is higher than that of wrought iron.
- Which of the following regarding the above statements is correct?
- a, b and c
 - c and d
 - only b
 - only d
32. (a) Silicone is a polymeric organo silicon compound which is chemically inert and thermally stable.
 (b) Silicon carbide can be used as lubricant.
 (c) Silicon dioxide is the raw material for the manufacture of cement as well as glass.
 (d) Hardness of SiO_2 and SiC is due to their regular tetrahedral structure.
- Which of the following regarding silicon and its compounds is correct?
- a and b
 - b and c
 - a, c and d
 - only d
33. (a) Density of monoclinic sulphur is more than rhombic sulphur due to the arrangement of puckered rings.
 (b) In a puckered ring one sulphur is bonded with 2 other sulphur atoms.

(c) The melting point of rhombic sulphur is considered as transition temperature of sulphur.

(d) Flower of sulphur is the vapour form of sulphur. Which of the following options regarding sulphur is correct?

- (1) only b
- (2) a and b
- (3) b and c
- (4) a, b and d

34. The statements given below are regarding the Contact process for the manufacture of H_2SO_4 .

- (a) Manufacture of SO_2 from sulphur is a reversible process.
- (b) High pressure, optimum temperature and specific catalyst is required to obtain a better yield of SO_3 .
- (c) SO_3 is hydrolyzed to get H_2SO_4 .
- (d) Pyrosulphuric acid is hydrolysed to get H_2SO_4 .

Which of the following options are correct regarding the manufacture of H_2SO_4 by Contact process?

- (1) a and d
- (2) b and c
- (3) only d
- (4) b and d

35. Certain statements regarding different varieties of glass are given below.

- (a) Addition of boron trioxide to the ingredients of glass makes it thermal resistant.
- (b) Addition of some transition metal oxides imparts colour to the glass.
- (c) Lead oxide is added to the ingredients of the glass to make it impact resistant.
- (d) Addition of cerium oxide to glass makes it photochromatic.

Which of the following options is correct regarding the above statements?

- (1) a and b
- (2) c and d
- (3) a, b and c
- (4) only d

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

1. 2	2. 1	3. 2	4. 3	5. 4	6. 2	7. 3	8. 3	9. 3	10. 1
11. 2	12. 1	13. 4	14. 3	15. 1	16. 4	17. 3	18. 3	19. 3	20. 4
21. 4	22. 4	23. 2	24. 3	25. 1	26. 3	27. 1	28. 4	29. 4	30. 4
31. 2	32. 4	33. 2	34. 3	35. 1					

PRACTICE EXERCISE 8 (B)

1. 4	2. 2	3. 4	4. 4	5. 3	6. 2	7. 3	8. 4	9. 4	10. 3
11. 4	12. 3	13. 3	14. 3	15. 1	16. 4	17. 4	18. 1	19. 4	20. 3
21. 1	22. 2	23. 1	24. 1	25. 4	26. 3	27. 2	28. 3	29. 4	30. 2
31. 1	32. 3	33. 1	34. 4	35. 1					

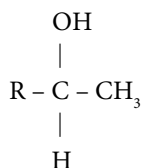
Organic Chemistry

SYNOPSIS

- Unique features of carbon which are responsible for properties of organic compounds are catenation and multiple bond formation.
- Degree of unsaturation in a hydrocarbon increases with decrease in the number of hydrogens attached to carbons.
- Chain isomerism is exhibited by all classes of organic compounds.
- A hydrocarbon should possess at least 4 carbon atoms to exhibit chain isomerism.
- Isoalkanes also possess position isomers.
- Alkenes and alkynes exhibit both chain isomerism and position isomerism.
- Decarboxylation involves reduction in number of carbon atoms from the parent compound.
- An alkane with 'n' carbon atoms can be prepared from a carboxylic acid with (n + 1) carbon atoms.
- Strong C – C bond in alkanes makes the addition reactions not favourable in them.
- The efficiency of a fossil fuel depends on the factors.
 - (a) Length of carbon chain in the hydrocarbon.
 - (b) Calorific value of fuel.
 - (c) Amount of CO₂ produced per gram.
 - (d) Presence of other impurities in the fuel.
- Lower fractions of petroleum refining are used as drying oils whereas higher fractions are used as lubricating oils. This depends on their boiling points.
- Branched chain hydrocarbons undergo degradation at a slower rate than straight chain hydrocarbons.
- Carbon forms large number of compounds due to the characteristic properties of catenation, multiple bond formation and isomerism.
- In the IUPAC nomenclature, functional group always gets priority over multiple bond or substituent.
- Chain isomers of alkanes differ with respect to the length of carbon chain whereas position isomers have same length of carbon chain with difference in the position of alkyl side chain or multiple bond or functional group.
- The carbon atom of –CHO group and –COOH group are given first position in their compounds. Hence they do not have position isomers.
- Alcohols and ethers are functional isomers and general molecular formula is C_nH_{2n+2}O.
- Aldehydes and ketones are functional isomers and general molecular formula is C_nH_{2n}O.
- Carboxylic acids and esters are functional isomers and general molecular formula is C_nH_{2n}O₂.
- Ethers, ketones and esters exhibit metamerism due to the presence of divalent functional groups.

- Alkanes give substitution reactions while alkenes and alkynes give addition reactions.
- Both alkenes and alkynes give decolourization with alkaline KMnO_4 or Br_2 . But only 1 – Alkynes give the characteristic reaction of acetylide formation.
- Aldehydes upon oxidation give carboxylic acids with same number of carbon atoms whereas ketones give carboxylic acids with less number of carbon atoms.
- Alcohols on dehydrogenation give aldehydes in presence of Cu at 300°C and give acids in presence of alk KMnO_4 .
- Carboxylic acids and alcohols react to give esters with fruity smell. The reaction is called esterification. Esters on hydrolysis in presence of acid or base gives the corresponding parent compounds.

- The compounds with structure



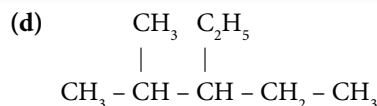
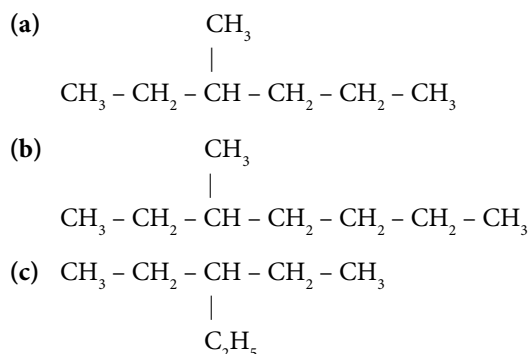
(R = H or alkyl group) only give iodoform reaction.

- Carbohydrates and proteins hydrolyse in the biological systems to form simple substances namely glucose and amino acids respectively.
- The characteristic reactions in organic chemistry require different types of reagents. The product sometimes depends on temperature also.

Type of reaction	Reagent	Product
Decarboxylation of sodium salts of fatty acid	Soda lime ($\text{NaOH} + \text{CaO}$)	Alkane with one carbon less than the parent compound
Dehydration of alcohols	Conc H_2SO_4 at (i) 170°C (ii) 140°C Al_2O_3 at (i) 350°C (ii) 250°C	(i) Alkene (ii) Ethers (i) Alkene (ii) Ethers
Dehalogenation of (i) dihaloalkane (ii) tetrahaloalkane	Zinc dust	(i) Alkene (ii) Alkyne
Hydrogenation	Nickel/ H_2	Saturated hydrocarbons
Hydroxylation of (oxidation) of alkenes	Alkaline KMnO_4	Glycols
Hydration (i) alkenes (ii) alkynes	$\text{H}_2\text{O}/\text{H}^+$ $\text{H}_2\text{O}/\text{HgSO}_4$	(i) Alcohol (ii) Aldehydes or ketones

Solved Examples

1. Write the IUPAC names of the following compounds.

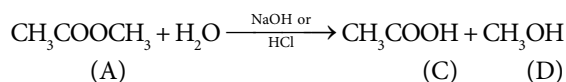
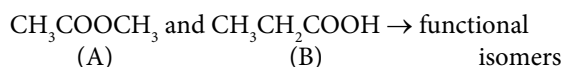


- ☞ **Solution:** (a) 3 – Methyl hexane
(b) 3 – Methyl heptane
(c) 3 – Ethyl pentane
(d) 3, 4 – Dimethyl hexane

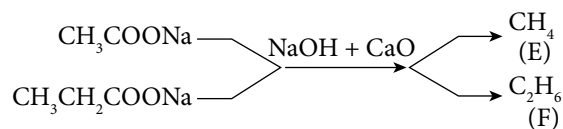
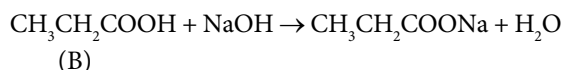
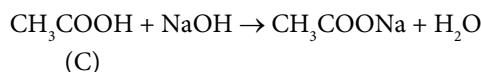
2. Two compounds A and B are functional isomers. A has fruity smell and undergoes hydrolysis in presence of acid or base to give C and D, C has same functional group as B. C and B are

simultaneously treated with sodium hydroxide. The compounds obtained are treated with soda lime to give two successive homologues E and F which are the first two members of the series. Identify A, B, C, D, E and F.

☞ **Solution:**



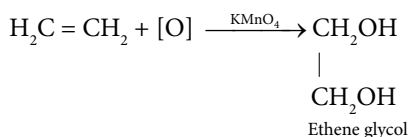
'C' has same functional group as 'B'



CH_4 and C_2H_6 are first two members of alkanes.

3. The first homologue of the series with general formula C_nH_{2n} on oxidation with alkaline KMnO_4 gives a compound which is added to water used as a coolant in automobiles. Identify the compound and explain the purpose of its addition to water.

☞ **Solution:** The first homologue of the series with general formula C_nH_{2n} is ethene.



Water is used as a coolant in automobiles because it can absorb large amount of heat from the engine due to high specific heat. However, in cold countries, the water may freeze to ice due to very low temperature. Similarly, in summer season water may tend to boil as it absorbs heat. Ethylene glycol is added to water which can prevent freezing as well as boiling. This is because addition of ethylene glycol to water leads to depression in freezing point as well as elevation in boiling point. As a result, water can maintain liquid range over a wide range of temperature.

4. Which reagents oxidize ethyl alcohol to acetaldehyde and acetic acid respectively? Why are two different reagents required for these conversions?

☞ **Solution:** Alkaline KMnO_4 oxidizes ethyl alcohol to acetic acid and copper at 300°C oxidizes ethyl alcohol to acetaldehyde.

Copper at high temperature removes molecule of hydrogen from ethyl alcohol to form acetaldehyde. It involves only dehydrogenation. Alkaline KMnO_4 produces nascent oxygen and oxidizes ethyl alcohol to acetic acid.

5. Why does starch form a thick paste when it is boiled with water?

☞ **Solution:** Starch is composed of two units namely amylose unit and amylopectin unit. Amylose is water soluble and amylopectin is water insoluble. On heating with water, amylose dissolves and amylopectin remains as such. Therefore starch becomes partially soluble and forms paste.

6. The vapour density of unsaturated acyclic aliphatic compound X is 35. Mention the chain isomers of alcohol with same number of carbon atoms as in X.

☞ **Solution:** The molecular mass of unsaturated acyclic aliphatic compound = $2 \times \text{Vapour density}$
 $= 2 \times 35 = 70$

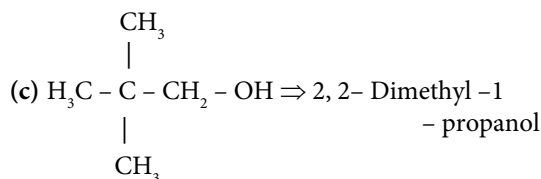
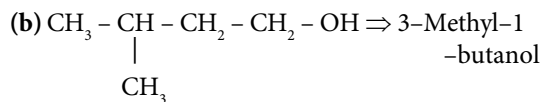
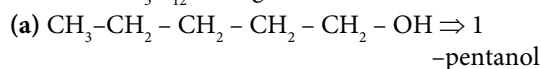
If X is alkene: $(\text{C}_n\text{H}_{2n})$

Molecular mass of X = 70

$$\Rightarrow (n \times 12) + (2n \times 1) = 70$$

$$\Rightarrow 14n = 70 \Rightarrow n = 5$$

Alcohol with 5 carbon atoms is $\text{C}_5\text{H}_{12}\text{O}$. The chain isomers of $\text{C}_5\text{H}_{12}\text{O}$ are given below.



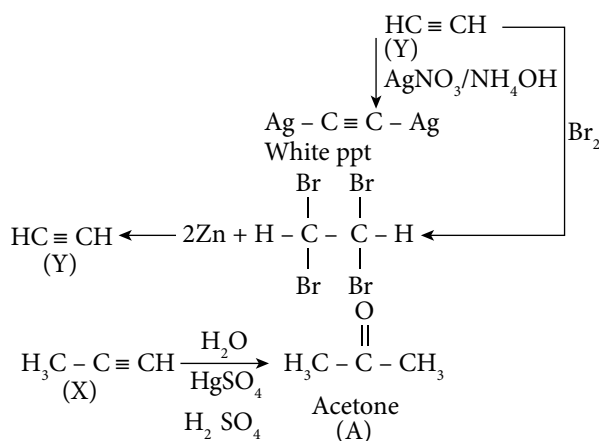
7. A hydrocarbon X decolourizes bromine water and its vapour density is 49. Identify the hydrocarbon X.

☺ **Solution:** Since 'X' decolourises bromine water, it is either alkene or alkyne. The molecular weight of X = $2 \times \text{vapour density} = 2 \times 49 = 98$

If X is alkene	If X is alkyne
The molecular weight = 98	The molecular weight = 98
$C_n H_{2n} = 98$	$C_n H_{2n-2} = 98$
$12n + 2n = 98$	$12 \times n + 2n - 2 = 98$
$n = \frac{98}{14} = 7$	$14n = 100 \Rightarrow n = \frac{100}{14}$
n is a whole number.	But n is not a whole number.
X is C_7H_{14}	

8. A hydrocarbon Y decolourizes bromine water. The saturated compound resulted in this reaction, on treatment with Zn dust gives back hydrocarbon Y. Y when passed through a solution of $AgNO_3$ dissolved in NH_4OH gives a white precipitate. The next higher homologue of Y that is X gives ketone A as the product upon addition of water. Identify X, Y, A and give equations.

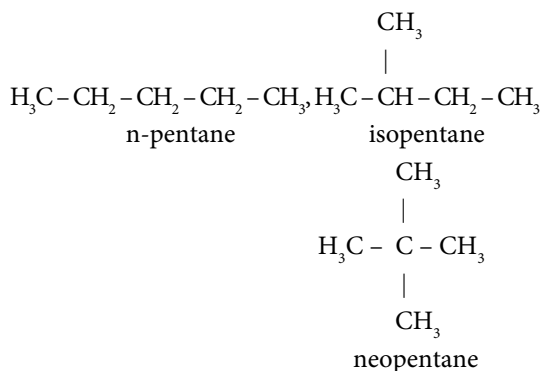
☺ **Solution:**



9. Identify the molecular formula of an alkane which has only three chain isomers. Suggest a suitable method of separation of these isomers and draw a comparison of their dipole moments.

☺ **Solution:** C_5H_{12} (Pentane) is the molecular formula of alkane which can give three chain isomers. When n-pentane, isopentane and neopentane are

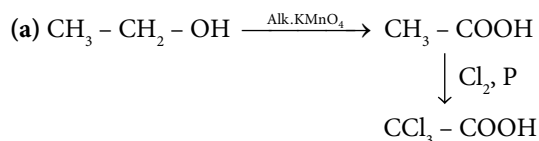
compared, the increase in branching decreases the surface area of the molecule. Therefore, the intermolecular forces of attraction decrease with increase in branching. As a result, the boiling points decrease. n-alkanes have the highest b.pt.s, iso alkanes have low b.pt.s and neoalkanes have least b.pt.s. Therefore, they can be separated by fractional distillation.



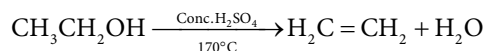
10. How do you bring about the following conversions?

- Ethyl alcohol to trichloroacetic acid.
- Ethene from ethanal
- Ethyne to acetic acid
- Acetylene to oxalic acid

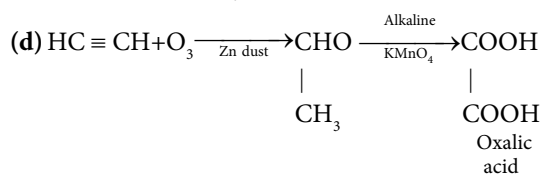
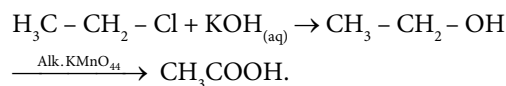
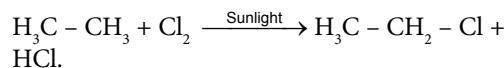
☺ **Solution:**



- (b) Ethene from ethanal



- (c) $\text{HC} \equiv \text{CH} + 2\text{H}_2 \xrightarrow{\text{Pd}} \text{H}_3\text{C} - \text{CH}_3$



PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

- Number of hydrogen atoms required to saturate 5 molecules of pentyne is _____.
(1) 10 (2) 20
(3) 5 (4) 15
- Preceding and succeeding homologues of $C_{10}H_{22}$ respectively are
(1) C_9H_{20} , $C_{11}H_{22}$ (2) C_9H_{20} , $C_{11}H_{24}$
(3) $C_{11}H_{24}$, C_9H_{20} (4) C_8H_{18} , C_9H_{20}
- The part of IUPAC name which indicates saturation or unsaturation is
(1) root word (2) primary suffix
(3) secondary suffix (4) prefix
- The various steps for writing IUPAC name of an organic compound are given below. Arrange the steps in the correct order.
(a) Numbering of carbon chain
(b) Identification of primary suffix
(c) Selection of the longest chain
(d) Identification of secondary suffix
(e) Identification of number and nature of alkyl groups attached to carbon chain
(1) c a b d e (2) c a e b d
(3) c b d a e (4) a c b d e
- Polymerization of ethylene gives _____.
(1) propylene (2) acetylene
(3) polyethylene (4) poly acetylene
- Addition of water to acetylene in presence of suitable catalyst produces _____.
(1) acetaldehyde (2) acetone
(3) ethyl alcohol (4) acetic acid
- The hydrocarbon obtained by treating sodium ethanoate with soda lime is _____.
(1) ethane (2) methane
(3) propane (4) butane
- Final product obtained by treating ethane with excess chlorine in presence of sunlight is _____.
(1) monochloro ethane (2) dichloro ethane
(3) tetrachloro ethane (4) hexachloro ethane
- Which of the hydrocarbons can not decolourize the red coloured solution of bromine in CCl_4 ?
(1) CH_4 (2) C_2H_4
(3) C_2H_2 (4) C_3H_6
- The hydrocarbons obtained by pyrolysis of ethane are _____ and _____.
(1) C_2H_4 , C_2H_2
(2) CH_4 , C_2H_2
(3) C_2H_4 , CH_4
(4) C_2H_2 , C_6H_6
- Which of the following compounds on hydrolysis produces methane?
(1) $CaCN_2$ (2) CaC_2
(3) Al_4C_3 (4) SiC
- Arrange the following hydrocarbons in the increasing order of volume of oxygen required for complete combustion per mole under the same conditions.
(a) Ethane (b) Propyne
(c) Ethyne (d) Propene
(e) Propane (f) Ethene
(1) c f a b d e (2) e d b a f c
(3) c b f d a e (4) e b d f a c
- 1 – propanol and 2 – propanol are _____ isomers.
(1) functional (2) position
(3) chain (4) stereo
- The product formed by decolourization of $KMnO_4$ by ethylene is _____ which is used as _____.
(1) ethane, oxidant
(2) ethyl alcohol, coolant
(3) ethylene glycol, antifreeze
(4) ethanol, reductant
- _____ of molasses takes place in the presence of enzymes.
(1) Fermentation
(2) Reduction
(3) polymerization
(4) Oxidation
- _____ gives yellow precipitate when treated with $I_2/NaOH$.
(1) Methanal (2) Methanol
(3) 2 – propanol (4) 1 – propanol

17. Which of the following is used to get absolute alcohol from rectified spirit?

- (1) CaO (2) Ca
(3) CaCO₃ (4) P₂O₅

18. Which of the following compounds on reduction with NaBH₄ gives 2-propanol?

- (1) Ethyl alcohol (2) Acetaldehyde
(3) Propanaldehyde (4) Acetone

19. Which of the following enzymes is required for the conversion of starch to maltose?

- (1) Diastase (2) Maltase
(3) Invertase (4) Zymase

20. Arrange the reactions given below in proper sequence for the conversion of ethane to methane.

- (a) Treatment with sodium hydroxide
(b) Treatment with aqueous KOH
(c) Treatment with NaOH + CaO
(d) Halogenation
(e) Reaction with acidified K₂Cr₂O₇
(1) e a d b c (2) d b e a c
(3) e c b a d (4) d e a b c

21. _____ give lather even with hard water due to the formation of _____.

- (1) Soaps, soluble salts
(2) Detergents, soluble salts
(3) Detergents, insoluble salts
(4) Soaps, insoluble precipitates

22. The chemical name of vitamin B₁₂ is _____

- (1) Calciferol (2) tocopherol
(3) pyridoxine (4) cyanocobalamine

23. In deodorant soaps, the additive added is

- (1) glycerol
(2) stearic acid
(3) potassium bicarbonate
(4) 3, 4, 5-Tribromo salicylaldehyde

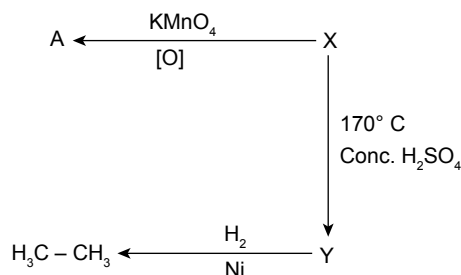
24. In case of natural rubber, the monomeric units are

- (1) isoprene (2) propene
(3) 1, 3-butadiene (4) vinyl chloride

25. Which among the following is a chromophore of azo dyes?

- (1) $\begin{array}{c} \diagup \\ \text{C=O} \\ \diagdown \end{array}$ (2) -NO
(3) -N≡N- (4) -NO₂

26. Complete the blanks by identifying X and Y.



- (1) Ethanal, ethene (2) Ethanol, ethene
(3) Ethanal, ethyne (4) Ethanol, ethyne

27. Compound A on treatment with copper at 300°C gives B and a gas C. It is possible to get back A from B and C in presence of D. Both B and A on treatment with certain reagent give same compound E, which on treatment with A, gives compound F with fruity smell. Identify the functional isomer of F.

- (1) CH₃OH (2) HCOOH
(3) CH₃COOH (4) HCHO

28. The molecular formula of organic compound X is C₅H₁₂O. The possible number of position isomers of X are

- (1) 4 (2) 3
(3) 2 (4) 7

29. The molar ratio of CO₂ and H₂O produced by the combustion of one mole of hydrocarbon X is 5 : 4. Identify the succeeding and preceeding homologues of X.

- (1) C₆H₁₄, C₄H₁₀ (2) C₆H₁₂, C₄H₈
(3) C₅H₁₀, C₇H₁₄ (4) C₆H₁₀, C₄H₆

30. Give the general formulae of monosaccharides and polysaccharides.

- (1) (CH₂O)_n, C_n(H₂O)_{2n}
(2) (CH₂O)_{2n}, C_n(H₂O)_n
(3) (CH₂O)_n, C_n(H₂O)_{n-1}
(4) (CH₂O)_{n-1}, C_n(H₂O)_{n+1}

31. From the list of alkenes given below, identify the alkenes which on ozonolysis give only ketones.

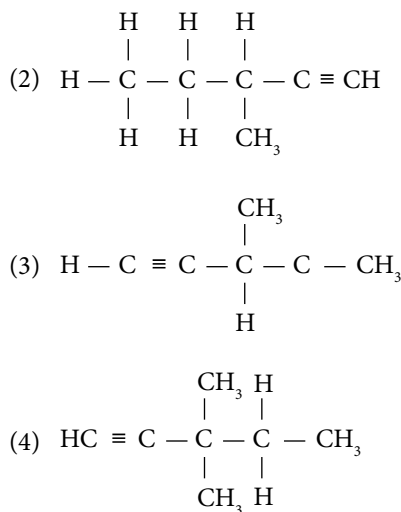
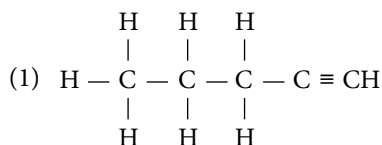
- (a) 2-methyl-1-butene
(b) 1-butene
(c) 2, 3-dimethyl-2-butene
(d) 3-methyl-2-pentene
(e) 3, 4-dimethyl-3-hexene
(f) 2, 5-dimethyl-2, 4-hexadiene

- (1) a, b and c (2) c, e and f
(3) d, e and f (4) c, d and e
32. From the list of compounds given, identify the compound which gives formaldehyde on treatment with suitable reagent.
- (a) Ethene (b) Ethyne
(c) Methanol (d) Formic acid
(e) Ethanol (f) Acetic acid
(1) a, c and d (2) b, c and d
(3) e, f and b (4) b, e and f
33. Identify position isomers among the following.
- (a) 3 – methyl 2 – hexene
(b) 2, 4 dimethyl 2 – pentene
(c) 2, 3 – dimethyl 2 – pentene
(d) 4 – methyl 2 – hexene
(e) 3, 4 – dimethyl 2 – pentene
- (1) a, d : b, c, e
(2) a, b : d, c, e
(3) b, c : a, e, d
(4) d, b : a, c, e
34. Identify disaccharides among the following.
- (a) Stachyose (b) Lactose
(c) Maltose (d) Raffinose
(e) Sucrose
(1) a, b, e (2) c, d, e
(3) b, d, e (4) b, c, e
35. From the compounds given below, identify the compounds which exhibit chain, position and functional isomerism.
- (a) Alcohols (b) Aldehydes
(c) Ketones (d) Carboxylic acids
(1) a, b (2) b, c
(3) c, d (4) a, c

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. The part of IUPAC name of the organic compound which denotes functional group is called _____.
(1) prefix
(2) primary suffix
(3) secondary suffix
(4) roor word
2. 1 – Pentene and 3 – Methyl-1-butene are _____ isomers.
(1) chain (2) position
(3) functional (4) metamers
3. Which of the following compounds contains a triple bond?
(1) C_2H_6 (2) C_4H_8
(3) C_5H_8 (4) C_5H_{12}
4. What is the correct structural formula of 3 – Methyl-1-pentyne?



5. Hexane exhibits chain isomerism. One of its isomers possesses two tertiary carbon atoms. Arrange the following steps in proper sequence to write IUPAC name for the respective isomer.
- (a) Identification of number of carbon atoms in the main chain
(b) Writing the structure of respective isomer of hexane
(c) Numbering of carbon chain

- (d) Giving position numbers for the alkyl groups attached to main chain
 (e) Identification of nature of tertiary carbon atom
 (1) b a c e d (2) e a b f d
 (3) b e c a d (4) e b a c d
6. _____ on hydrolysis gives ethyne gas.
 (1) CaC_2 (2) BeC_2
 (3) Al_4C_3 (4) SiC
7. Acetylene can form red precipitate of _____ when it is passed through ammonical cuprous chloride.
 (1) copper sulphate
 (2) copper acetylide
 (3) copper nitrate
 (4) polypropylene
8. Polymerization of acetylene gives _____.
 (1) propylene (2) poly acetylene
 (3) benzene (4) polypropylene
9. Saturated compound formed by the addition of halogen to acetylene is _____.
 (1) 1, 1, 2, 2, tetrahaloalkane
 (2) 1, 2 – dihaloalkane
 (3) 1, 1 – dihaloalkane
 (4) 2, 2 – dihaloalkane
10. Complete hydrogenation of ethyne gives _____.
 (1) ethane (2) ethene
 (3) methane (4) none of these
11. What is the number of hydrogen atoms present in the hydrocarbon formed by the hydrogenation of ethylene?
 (1) 4 (2) 6
 (3) 8 (4) 2
12. How many grams of hydrogen is required to saturate one mole of acetylene?
 (1) 3 g (2) 6 g
 (3) 10 g (4) 4 g
13. The compound formed when ethyl alcohol is treated with conc. H_2SO_4 at 170°C is _____.
 (1) ethane (2) ethene
 (3) ethyne (4) ethanal
14. By treating alkyl chloride with aqueous KOH, _____ is produced along with KCl.
 (1) alcohol (2) aldehyde
 (3) alkane (4) alkene
15. IUPAC name of CH_3COOH is
 (1) acetic acid (2) formic acid
 (3) methanoic acid (4) ethanoic acid
16. Which of the following compounds can be used to prepare ethene from ethyl alcohol?
 (1) Al_2O_3 (2) H_2SO_4
 (3) CaO (4) Both (1) and (2)
17. Which among the following reactions does not give methyl alcohol?
 (1) The reaction of ethylene with H_2SO_4 at 80°C
 (2) The reaction of water gas with hydrogen at high temperature
 (3) Alkaline hydrolysis of methyl bromide
 (4) Both (1) and (2)
18. The secondary suffix, 'one' indicates the following functional group in the compound.
 (1) $-\text{COOH}$ (2) $\begin{array}{c} \text{R} \\ \diagdown \\ \text{C} = \text{O} \\ \diagup \\ \text{R} \end{array}$
 (3) $\begin{array}{c} \text{H} \\ \diagdown \\ \text{C} = \text{O} \\ \diagup \\ \text{R} \end{array}$ (4) $-\text{OH}$
19. Identify the correct sequence of given steps for the conversion of calcium carbide to methyl alcohol.
 (a) Reaction with aqueous KOH
 (b) Hydrolysis
 (c) Reaction with soda lime
 (d) Reaction with $\text{HgSO}_4/\text{H}_2\text{SO}_4$
 (e) Reaction with HgSO_4
 (f) Reaction with PCl_5
 (1) b d e c f a (2) b d c a f e
 (3) b f d e a c (4) d b c e f a
20. _____ is the additive used in transparent soaps.
 (1) Potassium bicarbonate
 (2) Stearic acid
 (3) Salicylic acid
 (4) Glycerine
21. _____ is used to remove the sulphur impurity from crude oil.
 (1) SO_2 (2) CuO
 (3) P_2O_5 (4) NO_2
22. Antiseptics are a class of _____ drugs.
 (1) analgesic (2) antipyretic
 (3) tranquilizer (4) antibiotic

23. The compound with which hexamethylene diamine on polymerization gives nylon-6, 6 is
 (1) citric acid
 (2) adipic acid
 (3) oxalic acid
 (4) tartaric acid
24. The chemical name of vitamin D is
 (1) retinol
 (2) ferridoxin
 (3) calciferol
 (4) ergosterol
25. Example of a basic dye is
 (1) alizarin
 (2) indigo
 (3) martius yellow
 (4) malachite green
26. A hydrocarbon on ozonolysis gives one mole each of compounds A and B. Both A and B on reduction with sodium borohydride gives compounds C and D belonging to same homologous series. C has no position isomer whereas D has position isomer. A and B do not belong to the same homologous series. However, both A and B on oxidation with acidified KMnO_4 give same compound. Identify the hydrocarbon.
 (1) 3 - methyl 2 - butene
 (2) 2, 3 - dimethyl 1 - butene
 (3) 2 - methyl 2 - butene
 (4) 3, 4 - dimethyl 1 - butene
27. Mention the reagent used for the hydroxylation of alkenes.
 (1) Cold dil alkaline KMnO_4
 (2) Cold dil acidified KMnO_4
 (3) Cold dil acidified $\text{K}_2\text{Cr}_2\text{O}_7$
 (4) Cold dil alkaline $\text{K}_2\text{Cr}_2\text{O}_7$
28. Write the name of product obtained when ethene reacts with O_3
 (1) Acetaldehyde
 (2) Formaldehyde
 (3) Acetone
 (4) Formic acid
29. Two metals X and Y have 3 and 2 electrons in their valence shells 'M' and 'N' respectively. These metals can form binary compounds A and B with the same non-metal carbon. Both A and B can undergo hydrolysis forming hydrocarbons C and D. Identify C and D.
 (1) C_2H_6 , C_3H_4
 (2) C_3H_6 , C_3H_4
 (3) CH_4 , C_2H_2
 (4) C_4H_{10} , C_3H_6
30. The number structural isomers for pentene are
 (1) 3
 (2) 4
 (3) 5
 (4) 6
31. Ethyne on treatment with two reagents separately gives different products. One of the products belongs to same class of compounds. Identify the reagents.
 (a) $\text{O}_3 + \text{Zn dust}$
 (b) $\text{H}_2\text{SO}_4 + \text{HgSO}_4$
 (c) Alkaline KMnO_4
 (d) HOCl
 (1) a and d
 (2) b and c
 (3) a and c
 (4) b and d
32. From the list of compounds given below, identify the compounds which can give only two position isomers.
 (a) Hexane
 (b) Pentene
 (c) Heptyne
 (d) Propanol
 (e) Pentanone
 (1) a, d and b
 (2) b, d and e
 (3) e, a and c
 (4) b, c and d
33. Identify the essential amino acids among the following.
 (a) Leucine
 (b) Valine
 (c) Glycine
 (d) Lysine
 (e) Serine
 (1) a, b and c
 (2) b, d and e
 (3) a, b and d
 (4) b, d and c
34. Identify the compounds which give yellow precipitate with $\text{I}_2 + \text{NaOH}$.
 (a) Ethyl alcohol
 (b) Acetone
 (c) Propyl alcohol
 (d) 2 - propanol
 (e) 3 - butanone
 (f) Butanal
 (1) c, e and f
 (2) a, d and f
 (3) e, f and a
 (4) a, b and d
35. Identify the incorrect statements among the following.
 (a) The relative sweetness of fructose is the maximum and it is a reducing sugar.
 (b) The source of milk is lactose and it is non reducing sugar.
 (c) Maltose possesses glycoside bond between one glucose unit and one fructose unit and it is reducing sugar.
 (d) Glucose possesses aldehyde group and it is a non reducing sugar.
 (e) Molecular formula of sucrose is $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ and possesses glycoside bond between two glucose units.
 (1) a, b and c
 (2) b, c and d
 (3) c, d and e
 (4) a, d and e

ANSWER KEYS**PRACTICE EXERCISE 9 (A)**

1. 2	2. 2	3. 2	4. 1	5. 3	6. 1	7. 2	8. 4	9. 1	10. 3
11. 3	12. 1	13. 2	14. 3	15. 1	16. 4	17. 1	18. 4	19. 1	20. 2
21. 2	22. 4	23. 4	24. 1	25. 3	26. 2	27. 3	28. 2	29. 4	30. 3
31. 2	32. 1	33. 1	34. 4	35. 4					

PRACTICE EXERCISE 9 (B)

1. 3	2. 1	3. 3	4. 3	5. 3	6. 1	7. 2	8. 3	9. 1	10. 1
11. 2	12. 4	13. 2	14. 1	15. 4	16. 4	17. 1	18. 3	19. 1	20. 4
21. 2	22. 4	23. 2	24. 3	25. 1	26. 3	27. 1	28. 2	29. 3	30. 3
31. 3	32. 2	33. 3	34. 4	35. 3					

BIOLOGY

PART 5

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Fundamental Unit of Life

SYNOPSIS

- Cells are the fundamental structure and functional unit of life.
- Branch of biology that deals with various aspects of structure, chemistry and functioning of a cell is called **cell biology**.
- **Cell** was discovered by **Robert Hooke** and he **coined** the term 'cell' in **1665** which is a latin word from 'little room'.
- First living cell was observed by **Anton Van Leeuwenhoek** [**1674**] by his improved microscope.
- The 'Cell Theory' was formulated by two German biologists, **Matthias. J. Schleiden** [1838] and **Theodore Schwann** [1839] during their studies on plants and animals respectively.
- Cell theory accounts that plant and animals are composed of cells and cell products and cell is the basic unit of life.
- Cell theory was further elaborated by **Rudolf Virchow** [1855] as *Osmosis cellula e cellula* (i.e., all cells arise from pre-existing cells).
- **Viruses** are **exception to cell theory** as they are not composed of cell but only nucleic acid [DNA or RNA] surrounded by a protein sheath.
- Viruses are incapable of independent existence, regulation and self reproduction.
- The smallest cell is considered to be of **PPLO** [Pleuro Pneumonia Like Organisms] or **Mycoplasma**
- Smallest bacterial cell measures about 0.1 to 0.5 micrometre.
- The largest single cell is an **ostrich egg**.
- The longest animal cell is the **nerve cell** which is more than a meter long.
- Living blood cell is 9 μm and green alga *Acetabularia* is about 10 cm in length.
- Great variability occurs in cell shape i.e., spherical, polygonal, disc-like, cuboidal, columnar, spindle shaped, stellate etc.
- **Viruses, Viroids and Prions** are **not** considered as **living cells** or **organisms**.
- **Viroids** are **infectious free** (naked) RNA.
- **Prions** are **infectious proteins**

Structural Organization of Cell

- A cell is a mass of protoplasm which is surrounded by membrane and is capable of performing all the functions of life.
- A typical cell comprises of three functional regions: **Plasma membrane** or cell membrane, **nucleus** and **cytoplasm**.
- The cytoplasm possessing the cell organelles which forms the metabolic machinery, nucleus for its control and plasma membrane for its separation from the environment.

- Plant cells, fungi and many bacteria have an additional covering as the **cell wall**.

Plasma Membrane

- The outermost covering of all the cell separates the contents of the cell from its external environment and is **selectively permeable** membrane.
- The most widely accepted **fluid-mosaic** model of bio-membrane was proposed by **Singer** and **Nicholson in 1972**. The **fluid mosaic model** describes cell membrane as “**protein icebergs in a sea of lipids**”.
- Plasma membrane provides definite shape for the cell, acts as a mechanical barrier, cell to cell communication and transport of molecules across it.
- Passive transport [diffusion, osmosis], active transport and bulk transport take place through the plasma membrane.
- Hair like out growths of cell membrane include **Cilia** and **Flagella** help in cell movement.
- The protective layer present out side the plasma membrane in all the plant cells, fungi, some protists and prokaryotes is the **cell wall**.
- **Plant cell wall** is mainly made of **cellulose** where as in **fungi** it is **chitin**.
- In **bacteria**, the **cell wall** consists of **peptidoglycan** or **murein**.
- Extra deposition of **lignin**, **suberin** and **pectin** also present in plants.

Nucleus

- The largest cell structure and the master organelle with dense nucleoplasm that contains hereditary information is the nucleus.
- Nucleus is known to be the **brain of the cell**.
- Nucleus is bound by a double membraned **nuclear envelope** enclosing the nuclear sap or **nucleoplasm** which contains the **nucleolus**.
- Nucleus contains an intertwined mass of thin thread like structure made of DNA and proteins collectively known as **chromatin reticulum**.
- Chromatin reticulum condenses during cell division to form **chromosomes**.
- Chromosomes are the **seat of heredity** and responsible for the inheritance of characters.
- The **genes** are located on chromosomes.
- Some cells **lack nuclei** at their maturity as in **RBC** of mammals, **sieve elements** in plants.
- Some cells may have more than one nucleus ie., **syncytium** or **coenocyte**.

- Cells that have membrane bound nuclei are called **eukaryotes**.
- Cell that lack a membrane bound nucleus are **prokaryotes**.
- Prokaryotes comprise **bacteria** and **cyanobacteria** [blue green algae].
- Eukaryotes include plants, animals and protozoans.

Prokaryotic Cell

- Nuclear membrane absent
- **DNA circular** and **naked** and not combined with histones
- Nucleolus absent
- **Ribosomes** are of **70 S type** [50S + 30S]
- Membrane bound **cell organelles** are **absent**
- Cell size small ranging from 1 to 10 mm

Eukaryotic Cell

- Nuclear membrane present
- **DNA linear** and combined with proteins called histones
- Nucleolus present
- **Ribosomes** are of **80 S type** [60S + 40S]
- Membrane bound cell organelles, mitochondria, golgi complex, endoplasmic reticulum, lysosomes etc., present
- Cell comparatively larger in size 5 to 100 mm

Cytoplasm

- Cytoplasm is the protoplasmic mass of the cell seen inner to the plasma membrane excluding the nucleus consisting of the **cytosol** [fluid part] and **cell organelles**.
- On the basis of the membranous covering, cell organelles are of three types, **double membrane bound** [mitochondria, plastids], **single membrane bound** [endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles] and membrane less [ribosomes].

Mitochondria

- Mitochondria are rod shaped or sausage shaped cell organelles which are commonly called as “**the powerhouse of the cell**”.
- These are the site of synthesis of **high energy** compound. **ATP** [Adenosine Tri Phosphate].
- The ATP molecule is known as **energy currency of the cell**.
- **Mitochondria** are double membrane bound of which the inner membrane is inwardly folded to form **cristae**.

- **Cristae** contain specialized structures called **oxysomes** which serve as the **site of ATP synthesis**.
- Mitochondria enclose a **matrix** containing **DNA, ribosomes** and **enzymes**.
- DNA and ribosomes make it **semi, autonomous**.
- The enzymes are involved in aerobic respiration called **Kreb's cycle**.

Plastids

- Plastids are the **largest** among the **organelles** in the **plant cell**.
- **Leucoplasts** [colourless plastids] and **chloroplasts** [coloured plastids] are different types of plastids.
- Green chromoplasts are called **chloroplasts** and often called the '**kitchen of the cell**' because they are the sites of **photosynthesis**.
- Chloroplast is double membrane bound organelle enclosing the fluid **stroma** and membranous system called **grana** made up of stacked flattened sacs called **thylakoids** which contain **chlorophylls**.
- Stroma contains **enzymes** [for **dark reactions of photosynthesis**].
- **DNA, RNA** and **ribosomes** which make it **semi-autonomous** like mitochondria.

Endoplasmic Reticulum (ER)

- Endoplasmic Reticulum [ER] is a large network of membrane bound tubules, sheets or vesicles.
- ER is present in all cells except prokaryotes and mammalian erythrocytes.
- Depending on the presence or absence of ribosomes, there are two types of ER: **Rough ER** [with ribosomes on its surface] and **smooth ER** [devoid of ribosomes].
- **RER** functions in **protein synthesis** whereas **SER** is involved in **lipid synthesis**.
- ER also helps in intracellular and intercellular **transport** and **detoxification** of substances.

Golgi Apparatus

- **Golgi apparatus** or Golgi complex is an organelle of membrane bound sacs, tubules and vesicles.
- It is specialized in **secretion** and **packaging**.
- In plant cells, it is formed of separate units called **dictyosomes**.
- The membrane bound sacs of golgi apparatus are arranged in stacks called **cristern** or **cisternae** and **tubules** and **vesicles** seen towards the periphery.

Lysosomes

- **Lysosomes** are known as the '**suicidal bags**' of the cell.
- It is small spherical vesicles covered by a single membrane which contain **digestive enzymes**.
- Lysosomes are formed from **golgi apparatus** and function in **intracellular digestion**.
- Lysosomes are also called **digestive bags**.
- Due to their ability to kill and digest cellular components, lysosomes are called **suicidal bags**.

Vacuoles

- **Vacuoles** are membrane bound non-cytoplasmic sacs that contain non-living solid and liquid contents. Vacuoles may be of **sap vacuoles** meant for storage of **food vacuoles** [storage of food in single celled organisms], **contractile vacuoles** [excretion and osmoregulation] and **gas vacuoles** [buoyancy].
- The mature plant cells have a large central vacuole covered by **tonoplast** enclosing the **cell sap** which stores salts, sugar, amino acids, organic acids, proteins, waste products and pigments.
- Golgi apparatus along with ER, lysosomes and vacuoles constitute the **endo membrane system**.

Ribosomes

- **Ribosomes** are extremely small, rounded bodies found either in **free state** in the cytoplasm or **attached** to the surface of ER.
- These are composed of **RNA** and **proteins**.
- These are the **non-membrane** bound organelle **seen in both prokaryotes** as well as in **eukaryotes**.
- These are the sites of **protein synthesis** in the cell and are called as the **protein's factories** of the cell.
- Ribosomes found in **prokaryotic cell, mitochondria** and **plastids** are 70S type [50S + 30S subunits].
- In eukaryotic cell it is of **80S type** [60S + 40S subunits].
- The other non-membrane bound organelles include **cytoskeleton** (involved in **mechanical support** and maintain cell shape) and **centrosome** contains two cylindrical centrioles (help in **spindle formation** during cell division) contains two cylindrical **centrioles**.
- The **centrosomes** are **absent in plant cell**.
- Additional to the above cell organelles, single membrane bound microbodies like **peroxisomes** (in both plant and animals cells) and Glyoxisomes (in plant cells) are seen in the cytoplasm.

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Which among the following are prokaryotes?

- (1) Bacteria and Yeast
- (2) Blue-green algae and bacteria
- (3) Yeast and *Amoeba*
- (4) Bacteria and *Amoeba*

2. Which of the following is known as “physical basis of life”?

- (1) Gene
- (2) Nucleus
- (3) Protoplasm
- (4) Mitochondria

3. Which of the following can be made into crystal form?

- (1) Bacterium
- (2) *Amoeba*
- (3) Virus
- (4) Sperm

4. Choose the **incorrectly** matched pair.

- (1) Muscle cells – Disc shaped
- (2) Nerve cells – Long branched
- (3) Red blood cells – Spherical
- (4) *Amoeba* cells – No definite shape

5. Which of the following are **correct**?

- a. *Paramoecium* and *Amoeba* are unicellular eukaryotes.
- b. The egg of a hen is an aggregation of cells.
- c. Pseudopodia of *Amoeba* are used for movement and food capture.
- d. WBC in humans can change its shape.

The **correct** statements are given in

- (1) b, c and d
- (2) a, c and d
- (3) a, b and c
- (4) a, b and d

6. Select the mismatched pair from the following.

- (1) Theodore – Omnis cellula e cellula Schwann
- (2) Anton Van – Observed first living cell Leeuwenhoek
- (3) *Acetabularia* – The largest single celled green alga
- (4) Virus and – Exceptions to cell theory Coenocytic fungi

7. Metabolic wastes, pigments and mineral ions are generally seen in the cell organelle of plant is

- (1) Golgi complex
- (2) Endoplasmic reticulum
- (3) Vacuole
- (4) Lysosome

8. Select the one **wrongly** paired from the following.

- (1) Ribosomes – Single membrane bound organelle.
- (2) Mitochondrion – ‘Power house’ of the cell
- (3) Lysosome – ‘Suicidal bag’ of the cell
- (4) Chromatin – Genetic material DNA reticulum

9. Multinucleate condition of animal and plant cells are respectively known by

- (1) Coenocyte and syncytium
- (2) Prokaryote and eukaryote
- (3) Nucleoid and nuclein
- (4) Syncytium and coenocyte

10. Choose the **incorrect** statement from the following:

- (1) Plasma membrane is made up of phospholipid bilayer, proteins and small amount of carbohydrates.
- (2) Nucleus is the control room of the cell which controls and co-ordinates all the activities of the cell and is also responsible for heredity.
- (3) Cytoplasm is also called protoplasm.
- (4) Cytoplasm is the arena of all the metabolic activities of the cell.

11. The most abundant organic molecule seen in the cell is

- (1) Cellulose
- (2) Chitin
- (3) Collagen
- (4) Lignin

12. The substance present in the hard region of plant cells which provide strength is

- (1) Suberin
- (2) Pectin
- (3) Lignin
- (4) Cutin

13. The undefined nucleolar region of prokaryote is known as:

- (1) Nucleus
- (2) Nucleoid
- (3) Nucleolus
- (4) Nucleic acid

14. The largest cell organelle present in the plant cell is

- (1) Mitochondria
- (2) ER
- (3) Nucleus
- (4) Chloroplast

15. A chromosome consists of two similar strands called 1 attached to each other at a point known as 2.
- (1) 1 – Chromatids, 2 – Centromere
 - (2) 1 – Chromatin, 2 – Centromere
 - (3) 1 – DNA, 2 – Chromatin
 - (4) 1 – Chromatin, 2 – Nucleosome
16. The only one cell organelle seen in prokaryotic cell is:
- (1) Mitochondria (2) Plastids
 - (3) Ribosome (4) Lysosomes
17. Which of the following is an **incorrect** pair?
- (1) Storage sac of the cell – Lysosomes
 - (2) Transporting channel of the cell – Endoplasmic reticulum
 - (3) Packaging and exporting unit of the cell – Golgi complex.
 - (4) Brain of the cell – Nucleus
18. Mitochondria are the seat of
- (1) Krebs's cycle
 - (2) Calvin's cycle
 - (3) Anaerobic respiration
 - (4) Trapping of sunlight
19. Site of ATP synthesis in the cell is
- (1) Outer mitochondrial membrane
 - (2) Mitochondrial matrix
 - (3) Cisternae
 - (4) Cristae
20. Organelle which plays an important role in detoxification of drugs and toxins is
- (1) Golgi apparatus (2) Lysosomes
 - (3) Smooth ER (4) Vacuoles
21. Ribosomes are made up of
- (1) DNA (2) RNA
 - (3) Protein (4) RNA and protein
22. Which of the following is absent in plant cell?
- (1) Vacuole (2) Centriole
 - (3) Cell membrane (4) Mitochondria
23. Mature mammalian RBC does not contain:
- a. Nucleus b. ER
 - c. Ribosomes d. Mitochondria
- (1) a and c (2) b and c
 - (3) a, c and d (4) a, b, c and d
24. The cell organelle which is actively involved in membrane biogenesis is
- (1) Endoplasmic reticulum
 - (2) Golgi apparatus
 - (3) Lysosomes
 - (4) Vacuoles
25. Which of the following is a common feature of mitochondria and plastids?
- (1) Presence of DNA and ribosomes
 - (2) Ability to produce ATP
 - (3) Deeply folded nine membrane
 - (4) Presence of matrix called stroma
26. The term dictyosomes refers to
- (1) Ribosomes (2) Microsomes
 - (3) Golgi bodies (4) Lysosomes
27. Plastids which are involved in storage of proteins are
- (1) Chloroplasts (2) Aleuroplast
 - (3) Amyloplast (4) Elaeio plast
28. Sarcosomes are the
- (1) Ribosomes of muscle cells
 - (2) Peroxisomes of muscle cells
 - (3) Muscle fibres
 - (4) Mitochondria of muscle cells.
29. The organelle which is known as the scavenger of the cell:
- (1) Glyoxysomes (2) Centrosome
 - (3) Lysosomes (4) Vacuole
30. The 'currency of energy' in a typical living cell is
- (1) ATP molecule (2) ADP molecule
 - (3) Glucose molecule (4) Haemoglobin
31. Cell organelle involved in the formation of complex protein and lipid from simple sugars.
- (1) ER (2) Golgi apparatus
 - (3) Ribosomes (4) Plastids
32. Smallest cell organelle is
- (1) Ribosome
 - (2) Microtubules
 - (3) Microfilament
 - (4) Nucleolus
33. Self replicating cytoplasmic organelle seen in an animal cell is
- (1) Lysosome (2) Plastid
 - (3) Centriole (4) Golgi complex

34. Find out the **correct** statements:

- (1) Enzymes packed in lysosomes are made through rough ER.
- (2) Rough ER and smooth ER produce lipids and proteins respectively.
- (3) Endoplasmic reticulum is related with the destruction of plasma membrane.
- (4) Nucleotide is present inside the nucleoplasm of eukaryotic nucleus.

35. Cell organelles specialized in forming acrosome part of sperm is:

- (1) Mitochondrion
- (2) Centriole
- (3) Peroxisome
- (4) Golgi apparatus

36. Photosynthetic pigments are present in

- | | |
|----------------|------------|
| (1) Stroma | (2) Grana |
| (3) Thylakoids | (4) Matrix |

37. In all multicellular organisms, the 70S ribosomes are found in:

- (1) Nucleus
- (2) Chloroplast
- (3) Endoplasmic Reticulum
- (4) Mitochondria

38. Cell sap is the

- (1) Non-living fluid component of cytoplasm
- (2) Living fluid component of cytoplasm
- (3) Non-living fluid component of vacuole
- (4) Living fluid component of vacuole

39. Centrosome is present in

- | | |
|-----------------|---------------|
| (1) Chromosomes | (2) Nucleus |
| (3) Cytoplasm | (4) Nucleolus |

40. The functional unit of Golgi apparatus is:

- | | |
|----------------|---------------|
| (1) Thylakoids | (2) Cisternae |
| (3) Cristae | (4) Oxsomes |

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Identify the examples for anucleated cells:

- (1) Mature human erythrocytes
- (2) Sieve tube cells of vascular plants
- (3) Erythrocytes of amphibians
- (4) Both (1) and (2)

2. Which one among the following is a comma shaped form of bacteria?

- | | |
|--------------|---------------|
| (1) Bacillus | (2) Coccus |
| (3) Vibrium | (4) Spirillum |

3. Extra chromosomal genetic material associated with prokaryotic cell like bacterium is

- | | |
|--------------|--------------|
| (1) Nucleoid | (2) Mesosome |
| (3) Plasmid | (4) Plastid |

4. Middle lamella is associated to

- (1) Plant cell wall
- (2) Fungal cell wall
- (3) Cytoplasm
- (4) Cell membrane

5. A cell will swell up if:

- (1) The concentration of water molecules in the cell is higher than the concentration of water molecules in surrounding medium.
- (2) The concentration of water molecules in surrounding medium is higher than the water molecules concentration in the cell.
- (3) The concentration of water molecules is same in both the cell and in the surrounding medium.
- (4) Concentration of water molecules does not mean the swelling of cell.

6. Cells which lose their nucleus during differentiation are:

- | | |
|------------------|------------------|
| (1) Nerve cells | (2) Muscle cells |
| (3) Erythrocytes | (4) Leucocytes |

7. A nucleated differentiated cell that has lost the power to division is

- | | |
|----------------|-----------------|
| (1) Nerve cell | (2) Kidney cell |
| (3) Liver cell | (4) Leucocytes |

8. Gaseous exchange in cells takes place by:

- | | |
|---------------|-----------------|
| (1) Osmosis | (2) Exocytosis |
| (3) Diffusion | (4) Endocytosis |

9. Mitochondria was first observed in
 (1) Muscle cell (2) Plant cell
 (3) Bacteria (4) Fungi
10. Group of ribosomes joined by mRNA is called
 (1) Lysosomes (2) Microsomes
 (3) Polysomes (4) Mesosomes
11. The plastid commonly found in the petals of flower and fruits is
 (1) Amyloplast (2) Chromoplast
 (3) Chloroplast (4) Aleuroplast
12. The ribosomal RNA component is synthesized in a eukaryotic cell on
 (1) Nucleus (2) Nuclear pore complex
 (3) Nucleolus (4) Cytoplasm
13. Cell organelles taking part in photorespiration is
 (1) Peroxisome (2) Glyoxisome
 (3) Dictyosome (4) Chloroplast
14. Which one is common among nucleus, chloroplast and mitochondrion?
 (1) Cristae
 (2) Nucleic acids
 (3) Thylakoids
 (4) Carbohydrate metabolism
15. The best cell division stage to observe the shape, size and number of chromosome is
 (1) Metaphase (2) Interphase
 (3) Prophase (4) Telophase
16. A person takes concentrated solution of salt. After sometime he starts vomiting. What is the phenomenon responsible for the situation?
 (1) Exocytosis (2) Endocytosis
 (3) Endosmosis (4) Exosmosis
17. Match the contents of column I and column II and select the **correct** option given.
- | Column I | Column II |
|------------------|-----------------------|
| A. Nucleus | (i) Tonoplast |
| B. Vacuole | (ii) Cristae |
| C. Golgi complex | (iii) Double membrane |
| D. Mitochondria | (iv) Cisternae |
- (1) A - (iii) B - (i) C - (ii) D - (iv)
 (2) A - (iii) B - (i) C - (iv) D - (ii)
 (3) A - (i) B - (iii) C - (ii) D - (iv)
 (4) A - (i) B - (ii) C - (iv) D - (iii)
18. Dark reactions in photosynthesis take place in
 (1) Stroma (2) Matrix
 (3) Cytoplasm (4) Grana
19. Which of the following is/are ideal for observing typical plant cell?
 (1) *Hydrilla*, *Lotus* and *Elodea*
 (2) *Rhoeo*, *Vallisneria* and *Elodea*
 (3) *Elodea*, *Rhoeo* and *Tradescantia*
 (4) Sunflower, Rose and Lotus
20. Active transport across cell membrane requires
 (1) Glucose
 (2) Steroids
 (3) Energy in the form ATP
 (4) Proteins and glucose
21. Respiratory glycolysis occurs in
 (1) Centrosome
 (2) Nucleoplasm
 (3) Mitochondrial matrix
 (4) Cytoplasm
22. Sister chromatids of a chromosome are joined at
 (1) Chromocentre (2) Centromere
 (3) Satellite (4) Telomere
23. Organelle connected with glycosylation of proteins is
 (1) Ribosome (2) ER
 (3) Mitochondrion (4) Chloroplast
24. Which one of the following is not related to endoplasmic reticulum?
 (1) Involved in the formation of lysosomes
 (2) Helps in intracellular and intercellular transport of substances
 (3) Involved in membrane biogenesis.
 (4) Takes part in detoxification of toxins and drugs.
25. Nucleolus is the seat of
 (1) Protein synthesis
 (2) Ribosome organization
 (3) Enzyme synthesis
 (4) rRNA synthesis
26. The process of plasmolysis in plant cell may be defined as
 (1) Bursting of plasma membrane in a hypotonic medium.
 (2) Shrinkage of cytoplasm in hypertonic medium.

- (3) Breakage of plasmamembrane in a hypertonic medium.
 (4) Shrinkage of cytoplasm in hyypotonic medum.
27. Which one is the wrong statement regarding cell organelles?
- (1) Leucoplast are seen abundantly in roots and underground stems.
 (2) Lysosomes are double membrane vesicle budded off from Golgi bodies and contain hydrolytic enzymes.
 (3) Endoplasmic reticulum consists of a network of membranous tubules and helps in transport, synthesis and secretion.
 (4) Vacuoles are membrane bound non-cytoplasmic sacs that contain non-living metabolic wastes, minerals and pigments.
28. Disappearance of tadpole tail during metamorphosis is brought about by:
- (1) Lysosome
 (2) Golgi bodies
 (3) Peroxisomes
 (4) Endoplasmic reticulum
29. An elaborate network of cytoplasmic filamentous proteinaceous structures which help in the maintenance of cell shape are
- (1) Plasmalemma
 (2) Cytoskeletons
 (3) Endoplasmic Reticulum
 (4) Thylakoids
30. Consider the following statements:
- A. Plant cells have centrioles which are absent in almost all animals cell.
 B. Ribosomes are the site of protein synthesis.
 C. The middle lamella is the layer made up of calcium carbonate which holds the neighboring cells together.
 D. In animal cells, steroidal hormones are synthesized by smooth endoplasmic reticulum.
- The two wrong statements are
- (1) B and D (2) A and D
 (3) B and C (4) A and C
31. Which one of the following structure seen between two adjacent cells is an effective transport pathway?
- (1) Endoplasmic reticulum
 (2) Plamalemma
 (3) Plasmodesmata
 (4) Cytoskeletons
32. The structure that helps locomotion in prokaryotic cells is:
- (1) Cilia (2) Flagella
 (3) Pseudopodia (4) Both (1) and (2)
33. Protoplasm of the cell is of
- (1) Colloid nature (2) Suspension
 (3) Enulsion nature (4) True solution
34. Cellulosic cell wall is essential for plant cell because
- a. It gives shape to the cell.
 b. It gives protection to the cells.
 c. It can able to withstand high temperature, high wind speed and atmospheric moisture.
 d. It is involved in the recognition of substance required for the cells.
- The **correct** ones are given in
- (1) a, b and d (2) a, c and d
 (3) b, c and d (4) a, b and c
35. The movement of cilia and flagella is brought about by
- (1) Microtubules (2) Ribosomes
 (3) Microbodies (4) ER
36. The central mineral element seen in chlorophyll molecule is
- (1) Iron (2) Magnesium
 (3) Manganese (4) Sulphur
37. Cell organelle playing an important role in spindle formation during nuclear division is:
- (1) Chloroplast (2) Microtubules
 (3) Golgibody (4) Centriole
38. Peroxisomes are commonly seen in
- (1) Bundle sheath cells
 (2) Vascutr bundles
 (3) Mesophyll cells
 (4) Endopserm cells
39. Select the wrong statement about gene.
- (1) It is the unit of inheritance in living organisms.
 (2) It involved in the whole metabolism of cells.
 (3) It controls the transfer of hereditary characteristic from parents to offsprings.
 (4) Different combination of genes result different characteristics.
40. The structural material of fungal cell wall is
- (1) Pectin (2) Chitin
 (3) Peptidoglycan (4) Cellulose

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 2	2. 3	3. 3	4. 1	5. 2	6. 1	7. 3	8. 1	9. 4	10. 3
11. 1	12. 3	13. 2	14. 4	15. 1	16. 3	17. 1	18. 1	19. 4	20. 3
21. 4	22. 2	23. 4	24. 1	25. 1	26. 3	27. 2	28. 4	29. 3	30. 1
31. 2	32. 3	33. 3	34. 1	35. 4	36. 3	37. 4	38. 3	39. 3	40. 2

PRACTICE EXERCISE 1 (B)

1. 4	2. 3	3. 3	4. 1	5. 2	6. 3	7. 1	8. 3	9. 1	10. 3
11. 2	12. 3	13. 1	14. 2	15. 1	16. 4	17. 2	18. 1	19. 3	20. 3
21. 4	22. 2	23. 2	24. 1	25. 4	26. 2	27. 2	28. 1	29. 2	30. 4
31. 3	32. 4	33. 1	34. 4	35. 1	36. 2	37. 4	38. 3	39. 2	40. 2

Tissues

SYNOPSIS

- Group of cells having a common origin, similar on related structure which work together to perform a common function is called **tissue**.
- Study of tissues is called **Histology**.
- **Tissues** become organized to form **organs** and organs into **organ system**.
- The formation of tissues has brought about by the division of labour in multicellular organisms.

Plant Tissues

- Plant tissues are of two types: **Meristematic** and **Permanent**.
- Permanent tissues are of two types: **Simple** and **Complex**.
- Meristematic tissue comprises of a group of **thin walled, compactly arranged, immature cells** that have the **potential to divide** and form new cells.
- The regions where meristem is present can functions as growth region. These cells slowly grow, differentiate and mature into various components of permanent tissues.
- On the basis of position in the plant body, meristems are of three types: **apical** (growing tips of stems and roots), **intercalary** (intermediate position at the base

of leaves, internodes) and **lateral** (lateral side on stem and root).

- **Permanent tissues** comprises of cells that have **lost the ability to divide** and have assumed a permanent shape, size and formation.
- These are derived from meristematic cells by differentiation.
- Simple permanent tissues are those in which the permanent cells are similar in structure, origin and function.
- Simple permanent tissues are of three types: **Parenchyma**, **Collenchyma** and **Sclerenchyma**.

Parenchyma

- **Parenchyma** is the **most abundant tissue of plants** which are thin walled, relatively unspecialized living cells loosely packed with large inter cellular spaces.
- Main functions includes support, gaseous exchange, transportation, protection and storage of food.
- Chlorophyll containing parenchyma performing photosynthesis is called **chlorenchyma** and air cavity possessing parenchyma in aquatic plants providing buoyancy as **aerenchyma**.

Collenchyma

- Collenchyma is a simple permanent living tissue which provides **flexibility** to soft aerial parts so that they can bend without breaking.

- These cells are **unevenly thickened at conners** and provides **mechanical support** to the plants.

Sclerenchyma

- Sclerenchyma is a simple permanent **dead tissue** with highly **thick walled cells** made of **lignin**.
- It provides **mechanical support** to the plants.
- Sclerenchyma are of two types: **Fibres** (spindle shaped) and **sclereids** (short) or **stone cells** or **grit cells**.

Complex Tissues

- Complex permanent tissue are **heterogenous** in nature, composed of both living and dead cells of varying shapes, sizes and functions.
- The complex permanent tissues are conducting tissues like **Xylem** and **Phloem**.

Xylem

- Xylem is a complex tissue which performs the function of **transport of water** and mineral or sap inside the plant and also provides **mechanical strength**.
- Xylem is also called **wood** and consists of four types of elements: **Tracheids** **Vessels**, **Fibres** and **Parenchyma**.
- **Tracheids** are long, tubular **dead cells** with **lignified walls**, **wide lumen** and **tapering ends**.
- Tracheids possess various types of thickenings for mechanical strength and are **seen in Gymnosperms**.
- **Vessels** are long cylindrical tube like **dead cells** with **lignified walls** and a large central cavity.
- **Vessels** are **seen in Angiosperms**.
- Vessels and tracheids are conducting or **tracheary elements** of xylem.
- Xylem parenchyma consists of living cells which store food and other substances.
- Xylem fibres are sclerenchyma fibres which have thick walls, narrow lumen and tapering ends which provide **mechanical strength**.

Phloem

- Phloem is a complex permanent tissue which takes part in **conduction of organic food** inside the plant.
- Phloem is called **living conducting tissue** as its transport channels are made of living cells.
- It is also called **bast tissue**.
- Phloem is made of four types of elements. **Sieve elements**, **companion cells**, **phloem parenchyma** and **phloem fibres**.

- Sieve elements are elongated tubular living conducting channels of phloem. These are arranged end to end in linear rows with septa called **sieve plates** containing **sieve pores**.
- **Companion cells** are specialised **parenchymatous cells**, which are found closely associated with sieve tube elements.
- Companion cell and associated sieve tube cell are sister cells as they develop from same mother cell.
- **Phloem parenchyma** are thin walled, living cells which functions in storage and show **lateral conduction of food**.
- Phloem fibres are the only non-living component of phloem made up of sclerenchymatous fibres which are spindle shaped and possess narrow lumen.
- They provide mechanical strength to the tissue.
- Mature **sieve tube** elements are **enucleated** at maturity.
- Phloem fibres are also known as **bast fibres (Jute)**.

Tissue System in Plants

- Tissues are classified into three major categories: **epidermal tissue system**, **ground tissue system** and **vascular system**.

Epidermal Tissue System

- Epidermal tissue system forms the outer most covering of the whole plant body.
- Epidermis is usually single layered and made up of parenchymatous cells and is often covered with a **waxy** thick layer called **cuticle** which prevents the loss of water in young stem and leaves.
- In leaf epidermis, structures called **stomata** are present, which **regulate transpiration** and **gaseous exchange**.
- **Each stoma** is composed of two bean shaped cells known as **guard cells** and there enclose **stomatal pore**.
- In addition, the epidermis bears a number of **hairs on roots** which help in **water absorption** from the soil.
- The **epidermal hairs on the stem** are called **trichomes** which help in preventing water loss due to transpiration.

Ground Tissue System

- The internal regions **excluding the epidermis and vascular tissues** are known as **ground tissues**.
- **Ground tissue system** consists of simple tissues such as **parenchyma**, **collenchyma** and **sclerenchyma**.

- In leaves, the ground tissue consists of thin walled chloroplast containing cells called **mesophylls** which help in **photosynthesis**.

Vascular Tissue System

- Vascular tissue system comprises the complex tissues like **phloem** and **xylem**.
- The xylem and phloem together constitute **vascular bundles**.
- Vascular bundles may be **open** or **closed** types.
- In **dicot stem**, **cambium is present** between xylem and phloem and it helps in **secondary growth**.
- Vascular bundle **with cambium** is known as **open**.
- In **monocot stem**, **cambium is absent** and **no secondary growth** occurs, hence referred to as **closed type**.
- In **roots**, xylem and phloem in the vascular bundles are arranged in alternate pattern at different radii, the arrangement is called **radial**.
- In **stems** and **leaves**, xylem and phloem are arranged at same radius of vascular bundles and hence called **conjoint** and **collateral**.

Animals Tissues

- Animal tissues are group of cells specialized to perform special functions and organized to form organs which co-ordinate the animals body.
- Animal tissues can be broadly classified into four basic types on the basis of their structure and functions. These are: 1) **Epithelial tissue** 2) **Connective tissue** 3) **Muscular tissue** and 4) **Nervous tissue**.

Epithelial Tissue

- Epithelial tissue is a **fundamental animal tissue** which forms a continuous **sheet of closely packed cells** that covers all the external and internal surfaces of the animal body.
- It is the **simplest** animal tissue.
- The epithelial cells are compactly packed with little intercellular matrix.
- They generally **lack blood vessels** but have a good **power of repair** after injury.
- The **functions** of epithelial cells include **protection**, **absorption** and **secretion**.
- Epithelia are classified on the basis of arrangement of layers, cell shape and functions.

- On the basis of arrangement of layers, these are;
- **Simple epithelium:** The tissue is made of a **single layer** of cells
- **Stratified/compound epithelium:** The tissue consists of **more than one layer** of cells.
- On the basis of cell shapes, the epithelial tissues are of three types: **Squamous**, **cuboidal/cubical** and **columnar**.

Squamous epithelium

- Squamous epithelium is composed of a single layer of flat, tile, like polygonal cells. It is also called **pavement epithelium**.
- Squamous epithelium may be **simple** (single layered) or **stratified** (compound or multilayered).
- Simple squamous epithelium occurs in lung alveoli, Bowman's capsule, blood capillaries etc.
- Stratified squamous epithelium occurs in areas where there is **regular wear and tear** occurs eg: buccal cavity, pharynx, skin etc.

Cuboidal epithelium

- Cuboidal epithelium consists of short, cube shaped cells with round centrally placed nucleus.
- Micro villi seen on the free surface of this tissue add an increasing absorptive area.
- Cuboidal epithelium is of two types: **simple** and **stratified**.
- Simple cuboidal epithelium occurs in the lining of kidney tubules, ducts of salivary and thyroid gland, germinal epithelium of sex organs etc.
- Cuboidal epithelium takes part in secretion, excretion and absorption.

Columnar epithelium

- Columnar epithelium consists of tall pillar like compactly arranged cells.
- Nucleus is oval and lies near the base of the columnar epithelial cell.
- Free surface may bear a number of tiny finger like projections called **micro villi** which increase the absorptive area.
- Like other epithelia, columnar epithelium may be **simple** and **stratified**.
- These occurs in the lining layer of stomach, intestine and their glands.

- On the basis of specific functions, the epithelial tissues are of two types: **Ciliated** and **Glandular**.
- Ciliated epithelium is columnar or cuboidal where the cells **bear cilia on their free surface**.
- Ciliated epithelium occurs in sperm ducts, uriniferous tubules, lining of respiratory tract and oviducts.
- Glandular epithelium is either columnar or cuboidal which is often infolded to form multicellular glands which secrete chemical substances. E.g., sweat glands, oil glands, digestive glands and endocrine glands.

Connective Tissue

- Connective tissue is the **most abundant tissue** seen in the animal body.
- These have scattered living cells embedded in an abundant matrix that helps in connecting, binding, packing and supporting different structure of the animal body.
- In all connective tissues except blood, the **cells secrete fibres** of structural proteins called **elastin** and **collagen**.
- The fibres provide strength, elasticity and flexibility to the tissues.
- Cells also secrete modified polysaccharides which accumulate between cells and fibres and act as **ground substance** or matrix.
- Connective tissue are classified into three types as
 - 1) **Loose connective tissue**
 - 2) **Dense connective tissue**
 - 3) **Specialized connective tissue**
- **Loose** connective tissue has cells loosely arranged in the matrix eg: **Areolar** tissue (found beneath the skin) and **adipose** tissue (storage of fats).
- **Dense** connective tissue has abundant fibres and smaller amount of matrix eg: **Ligaments** (connecting bone to bone) and **tendons** (connecting bone to muscle).
- **Specialized connective tissue** includes **cartilage**, **bone** and **blood**.
- **Cartilage** is firm but flexible **supportive** connective tissue in which the solid matrix contains living cells called **chondrocytes**.
- **Cartilage** is present in the tip of nose, outer ear joints, epiglottis, larynx, trachea and inter-vertebral discs.
- **Bone** is a solid, rigid, non-flexible tissue **rich in calcium salts** and **collagen fibres** which give them its strength.
- Bone is the main tissue which forms the structural framework of the body and protects the soft organs.

- The **bone cells** or **osteocytes** are present in spaces called **lacunae** around nutrients filled **Haversian canals**.
- The bone cavities contain an internal soft special connective tissue called **bone marrow** which are the **sites of blood cell formation**.
- **Blood** is the vascular connective tissue containing **plasma**, **red blood cells (RBC)**, **white blood cells (WBC)** and **platelets**.
- Plasma constitutes 55% of the blood and contains **plasma proteins**.
- Plasma proteins are **albumin globulin** and **fibrinogen**.
- Blood is the main **circulating fluid** that helps in transport of various substances.
- **RBC** contains the reddish pigment called **haemoglobin** for **transport of oxygen** and CO_2 .
- WBC are colourless nucleated cells mainly providing immunity.
- Platelets are non-nucleated colourless cells helping in blood coagulation or clotting.
- **RBCs are enucleated** and devoid of **other cell organelles**.
- WBCs are also known by **leucocytes**.
- **Neutrophils**, **eosinophils** and **basophils** are **granulocytes** of WBCs.
- **Lymphocytes** and **monocytes** are the **agranulocytes** of WBCs.

Muscular Tissue

- Muscular tissue is a **contractile tissue** which is responsible for **movements** and **locomotion**.
- Cells of the muscular tissue are elongated and are called **muscle fibres**.
- The contractile elements of muscle fibres are called **myofibrils** with two types of protein filaments as **actin** and **myosin**.
- These actins and myosins overlap in parallel fashion and produce striations in muscle cells.
- **Muscular tissue** occupies **nearly 40% of total weight** of the body.
- Muscles are classified on the basis of their location, appearance and nature of regulation of their activities as
 - 1) **Striated muscles**
 - 2) **Smooth muscles**
 - 3) **Cardiac muscles**

Skeletal/Striated Muscles

- Skeletal/striated muscles are closely associated with the skeletal components of the body.
- These have a **striped appearance** and hence are called **striated muscles**.
- These are long, cylindrical cells and are **multinucleate (syncytium)**.
- Striated muscles are **voluntary in their action** and are primarily involved in **locomotory actions** and **changes of body postures**.

Smooth Muscles

- **Smooth muscles** are non-striated and are located in the inner walls of hollow visceral organs of the body like alimentary canal, reproductive tract etc.
- These are spindle shaped, unbranched and uninucleate.
- Smooth muscles are **not** under the **voluntary** control of the nervous system and are **involuntary**.
- These assist in the **transportation of food** through the digestive track and **gametes** through the genital tract.

Cardiac Muscles

- **Cardiac muscles** are involuntary, striated and non-fatigued muscles fibres which are the **muscles of heart**.
- The fibres are short, cylindrical and branched.
- In the area of union between two adjacent cells, zig-zag junctions are present and are called **intercalated discs** which allows them to contract as a unit.

Nervous Tissue

- **Nervous (neural) tissue** is a tissue specialised in **reception, integration** and **transmission of stimuli** or **impulses** to various parts of the body.
- The brain, spinal cord and nerves are all composed of the nervous tissue.
- The cells of nervous tissue are called **nerve cells** or **neurons**.
- A neuron consists of a **cell body** with a nucleus and cytoplasm, from which long thin hair like parts arise.
- Usually each neuron has a single long part called the **axon** and many short, branched parts called **dendrites**.
- **Dendrites pick up impulses** and transmit towards the **cell body** where **axon** carries impulses away from the cell body.
- Axon is surrounded by a sheath of special connective tissue cells called **Schwann cells**.
- Nerve fibres are of two types like **Myelinated** (which possess **myelin sheath**) and **non-myelinated (without myelin)**.
- In myelinated nerve fibres, at places **myelin is absent** is called **Nodes of Ranvier**.
- Junctions of nerve endings with adjacent neurons are called **synapses** and are **mean for transmission of impulses** from one neuron to the next.
- Transmission of impulse is generally carried out with the help of chemical **neuron transmitter** called **acetylcholine**.

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the following features of tissues.

- A. They are similar or dissimilar cells
- B. They are performing a common function.
- C. They have common origin.
- D. They are characterised by distinct cell wall.

The **correct** ones are grouped in

- (1) A, B and D (2) B, C and D
- (3) A, B and C (4) A, C and D

2. Which of the following helps in increasing the height of plant?

- (1) Apical meristem
- (2) Cambium
- (3) Intercalary meristem
- (4) Vascular bundle

3. Permanent tissues differ from meristematic tissue in

- A. Inability to divide
- B. Attainment of definite size and shape.
- C. Performing a distinct function
- D. Ability to divide

- (1) A, B and C (2) A, C and D
- (3) B, C and D (4) A, B and C

4. Parenchyma cells involved in photosynthesis are

- (1) Aerenchyma
- (2) Chlorenchyma
- (3) Sclerenchyma
- (4) Collenchyma

5. Grittiness of fruit wall is due to the presence of

- (1) Sclerids (2) Sclerenchyma fibres
- (3) Tracheids (4) Collenchyma

6. Which of the following elements of xylem helps in lateral conduction of water?

- (1) Xylem tracheids
- (2) Xylem parenchyma
- (3) Xylem vessels
- (4) Xylem fibres.

7. Plant tissue responsible for stiffness in husk of coconut is

- (1) Sclerids (2) Phloem cells
- (3) Xylem fibres (4) Sclerenchyma fibres

8. The most abundant tissue seen in *Hydrilla* and *Eichhornia* plants is

- (1) Aerenchyma (2) Collenchyma
- (3) Sclerenchyma (4) Phloem

9. Xylem vessels are absent in

- (1) Dicotyledons (2) Monocotyledons
- (3) Gymnosperms (4) Angiosperms

10. Cork cells are generally impervious to water and gases because of the presence of:

- (1) Cellulose (2) Suberin
- (3) Pectin (4) Lignin

11. Which of the following tissues have cells with large central vacuoles and irregular thickening at the corner?

- (1) Parenchymatous tissue
- (2) Collenchymatous tissue
- (3) Sclerenchymatous tissue
- (4) Meristematic tissue

12. The dead cell component present in phloem is:

- (1) Phloem fibres
- (2) Companion cells
- (3) Phloem parenchyma
- (4) Sieve tube

13. The chemical substance present in the thickening wall of collenchyma is

- (1) Lignin (2) Cellulose
- (3) Pectin (4) Both (2) and (3)

14. Select the **incorrect** pair from the following.

- A. Parenchymatous tissues have intercellular spaces.
 - B. Apical and intercalary meristems are permanent tissues.
 - C. Aerenchyma is specialized for photosynthesis.
 - D. Collenchymatous tissues are irregularly thickened at the corners.
- (1) A and C (2) A and D
 - (3) B and C (4) B and D

15. Morphology of economically using jute, flax and hemp is

- (1) Phloem fibres (2) Xylem fibres
- (3) Fibres and sclereids (4) Bark layer

16. Most abundant tissue seen in animal body is:
(1) Epithelial tissue (2) Connective tissue
(3) Muscular tissue (4) Nervous tissue
17. Which part of the bone is specialized to form the cells?
(1) Harvesian canal (2) Osteoblasts
(3) Osteocytes (4) Red bone marrow
18. Tissue formed in area of regular wear and tear is:
(1) Simple cuboidal
(2) Simple squamous
(3) Stratified squamous
(4) Stratified cuboidal
19. The epithelium which forms the inner wall of blood vessels is
(1) Cuboidal epithelium
(2) Ciliated epithelium
(3) Squamous epithelium
(4) Compound epithelium
20. The dense strong tissue with parallel bundles of collagen fibres which joints a skeletal muscle with a bone is called:
(1) Tendon (2) Ligament
(3) Fibroblast (4) Elastin
21. Plasma content of connective tissue blood is
(1) 80% (2) 55%
(3) 65% (4) 95%
22. Cells of cartilaginous tissue are called
(1) Osteocytes (2) Choanocytes
(3) Melanocytes (4) Chondrocytes
23. Fibroblasts, macrophages and mast cells are present in
(1) Adipose tissue
(2) Areolar tissue
(3) Cartilaginous tissue
(4) Compound epithelium
24. Matrix of bone consists of:
(1) Ossein
(2) Phosphate
(3) Carbonates of calcium and magnesium
(4) All (1), (2) and (3)
25. The connective tissue known as 'middleman' is
(1) Lymph (2) Blood
(3) Serum (4) Bone
26. Which of the following is non-vascular?
(1) Nervous tissue (2) Connective tissue
(3) Epithelial tissue (4) Muscular tissue
27. Fats are stored in human body as:
(1) Areolar tissue (2) Adipose tissue
(3) Cartilage (4) Bone marrow
28. Striated muscles which are voluntary in nature
(1) Skeletal muscles (2) Cardiac muscles
(3) Smooth muscles (4) Visceral muscles
29. Most abundant blood cells among the WBCs are:
(1) Erythrocytes (2) Monocytes
(3) Neutrophils (4) Lymphocytes
30. Maximum intercellular substance is found in
(1) Connective tissue (2) Nervous tissue
(3) Muscular tissue (4) Epithelial tissue
31. In cardiac muscles, certain communication junctions to the fusion points allow the cells to contract as a unit and is known as
(1) Interstitial disc (2) Interdigitated disc
(3) Cell junctions (4) Intercalated disc
32. Pick out the wrong statement regarding muscular tissue:
(1) Muscular tissue comprises 40 to 50% of body weight.
(2) It is the abundant tissue in animals body.
(3) It is mesodermal in origin
(4) The main function includes movements and locomotion.
33. Nodes of Ranvier are areas where:
(1) Joints occur between adjacent axons
(2) Axon terminal forms synapse with dendrites.
(3) Dendrites of one nerve cells to adjacent nerve cells
(4) Non-myelinated areas of myelinated nerve fibre
34. A nerve cell transmits it's impulse to another through its:
(1) Dendrite (2) Cyton
(3) Axons (4) Synaptic knob
35. Area of coming together of two neuron ends in between a dendrite and axon end is known as
(1) Synapse (2) Synapsis
(3) Cell junction (4) Synapticula

36. Voluntary muscles are found in
 (1) Alimentary canal (2) Limbs
 (3) Iris of eye (4) Bronchi
37. Muscular tissues which function throughout the life continuously without fatigue is
 (1) Skeletal muscle
 (2) Smooth muscle
 (3) Cardiac muscle
 (4) Voluntary muscle
38. Intestine absorbs the digested food material. What type of epithelial cells are responsible for this absorption?
 (1) Stratified epithelium
 (2) Columnar epithelium
 (3) Cuboidal epithelium
 (4) Squamous epithelium
39. Cells which are long, cylindrical, unbranched and multinucleate are:
 (1) Striated muscles (2) Smooth muscles
 (3) Areolar tissue (4) Cardiac muscles
40. The connective tissue found at the tip of nose, outer ear joints, larynx and trachea are
 (1) Bone (2) Tendon
 (3) Ligament (4) Cartilage

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

- Which one of the tissue forms the major part within the organs of plants?
 (1) Parenchyma (2) Fibres
 (3) Collenchyma (4) Sclereids
- Which one of the following characteristic feature is not applicable to parenchyma?
 (1) It forms the major tissue within organs.
 (2) Cells are generally brick shaped closely packed with intercellular spaces.
 (3) Their walls are thin and made up of cellulose.
 (4) Parenchyma perform the functions like photosynthesis, storage, secretion and mechanical support.
- Choose the incorrect pair from the following:
 (1) Guard cells – Seen around the stomatal pore
 (2) Collenchyma – Living mechanical tissue
 (3) Aerenchyma – Dead mechanical tissue
 (4) Chlorenchyma – Seat of photosynthesis
- The presence of vessels and companion cells are the characters of:
 (1) Gymnosperms (2) Angiosperms
 (3) Pteridophytes (4) Bryophytes
- Find the incorrect statements from the following:
 A. Root hairs are multicellular elongation of the epidermal cells.
 B. Trichomes are unicellular epidermal hairs of the stem.
 C. Guard cells are specialized cells regulating opening and closing of stomata.
 D. Cuticle, collenchyma and stomata are absent in roots
 (1) A, C and D are incorrect
 (2) B, C and D are incorrect
 (3) A and B are incorrect
 (4) B and D are incorrect
- Conjoint, closed type of vascular bundles are characteristic of:
 (1) Monocot stem (2) Dicot stem
 (3) Monocot root (4) Dicot root
- The small aerating pores seen on cork layer of woody stem are
 (1) Guard cells (2) Subsidiary cells
 (3) Trichomes (4) Lenticels
- Which of the following is/are composed of dead cells?
 (1) Sclerenchyma (2) Tracheids
 (3) Vessels (4) All (1), (2) and (3)
- The length of stem increases due to
 (1) Cambial activity (2) Apical meristem
 (3) Lateral meristem (4) Cork cambium
- Some parts of the plants are flexible due to the presence of:
 (1) Parenchyma (2) Sclerenchyma
 (3) Collenchyma (4) Meristem

11. Which of the following is not a feature or function of epidermis?
- (1) Thick walled cells
 - (2) Protection from mechanical injury
 - (3) Gaseous exchange through stomatal pores
 - (4) Trichomes and glandular hairs.
12. Match the contents of column I with column II:
- | Column I | Column II |
|----------------|----------------------------|
| A. Xylem | (i) Gaseous exchange |
| B. Lenticels | (ii) Translocation of food |
| C. Guard cells | (iii) Transport of sap |
| D. Phloem | (iv) Transpiration |
- (1) A - (i), B - (ii), C - (iii), D - (iv)
 - (2) A - (iii), B - (i), C - (iv), D - (ii)
 - (3) A - (ii), B - (i), C - (iv), D - (iii)
 - (4) A - (iii), B - (iv), C - (i), D - (ii)
13. The covering tissue of external and internal surfaces of animal body is
- (1) Connective
 - (2) Epithelial
 - (3) Muscular
 - (4) Areolar
14. Trapped dust particles are cleaned from the respiratory tract by:
- (1) Ciliated epithelium
 - (2) Stratified epithelium
 - (3) Glandular epithelium
 - (4) Sensory epithelium
15. Largest cells in human blood are:
- (1) Erythrocytes
 - (2) Neutrophils
 - (3) Monocytes
 - (4) Basophils
16. The principal cation present in the blood plasma is
- (1) K^+
 - (2) Mg^{2+}
 - (3) Ca^{2+}
 - (4) Na^+
17. Choose the wrong pair regarding connective tissue:
- (1) In most of the connective tissues, the cells secrete fibres made up of collagen and elastin.
 - (2) It is ectodermal in origin
 - (3) Ligaments connect the bone to muscles whereas tendon connects bone to bone.
 - (4) Connective tissue helps in connecting, binding, packing and supporting different structures of the animal body.
18. The striated muscles are
- (1) Multinucleate
 - (2) Uninucleate
 - (3) Binucleate
 - (4) Anucleate
19. The epithelium of the alveoli of lung is
- (1) Stratified epithelium
 - (2) Columnar epithelium
 - (3) Squamous epithelium
 - (4) Cuboidal epithelium
20. Hardest substance of the body is
- (1) Bone
 - (2) Enamel
 - (3) Cartilage
 - (4) Tendron
21. Which of the following are involved in body defence?
- (1) Neutrophils
 - (2) Lymphocytes
 - (3) Macrophages
 - (4) All (1), (2) and (3)
22. Ground substance of connective tissue is formed of:
- (1) Phospholipids
 - (2) Lipids
 - (3) Monosaccharides
 - (4) Muco polysaccharides
23. The characteristic features to identify a nerve cell are:
- (1) Cell body with branched cytoplasmic extensions at one end and long projections at the other end.
 - (2) Rounded or oval cells with bilobed nucleus and cytoplasmic granules.
 - (3) Spindle shaped cell with a big central nucleus.
 - (4) Red coloured, biconcave disc shaped enucleated cells.
24. Choose the incorrect matching from the following.
- (1) Fluid connective tissue – Blood
 - (2) Striated muscle – Skeletal muscle
 - (3) Epithelial tissue – Simplest animal tissue
 - (4) Nervous tissue – Contractibility
25. Dislocation of bones occurs in persons who have met with and met in accidents due to the
- (1) Tendon break
 - (2) Break of skeletal muscle
 - (3) Ligament break
 - (4) Areolar tissue break
26. Which of the following helps in repair of tissue and fills up the space inside the organ?
- (1) Tendon
 - (2) Areolar
 - (3) Adipose
 - (4) Cartilage
27. The epithelium found in the inner lining of stomach, intestine and their glands is
- (1) Columnar
 - (2) Cuboidal
 - (3) Squamous
 - (4) Cubical

28. The cytoplasm of a muscle cell is known as
 (1) Neuroplasm (2) Sarcolemma
 (3) Axoplasm (4) Sarcoplasm
29. Nissl's granules of neurons are made of:
 (1) Ribosomes/RER (2) SER
 (3) DNA (4) Golgi complex
30. Matrix of bone contains the spaces called:
 (1) Haversian canal (2) Osteoblast
 (3) Lacunae (4) Canaliculi
31. The blood component essential for blood coagulation is:
 (1) Albumin (2) Globulin
 (3) Fibrinogen (4) Vitamins
32. The least leucocytes of human blood is:
 (1) Eosinophil
 (2) Basophil
 (3) Monocyte
 (4) Neutrophil
33. Fundamental repeating unit of skeletal myofibrils is
 (1) Motor unit
 (2) Sarcoplasmic reticulum
 (3) Cross, bridges
 (4) Sarcomere
34. Cells of germinal epithelium are
 (1) Cuboidal (2) Columnar
 (3) Squamous (4) Ciliated
35. Which one acts as shock absorber, when two bones come together?
 (1) Cartilage (2) Ligament
 (3) Tendon (4) Disc
36. Lining layer of fallopian tubes, nasal passages, bronchi and bronchioles consists of:
 (1) Squamous columnar epithelium
 (2) Ciliated columnar epithelium
 (3) Stratified columnar epithelium
 (4) Cuboidal epithelium
37. Major constituent of connective tissue is
 (1) Collagen (2) Lipid
 (3) Cholesterol (4) Carbohydrate
38. Brush border of small intestine cells formed of:
 (1) Microvilli (2) Cilia
 (3) Rugae (4) Circular folds
39. Schwann cells are associated with:
 (1) Skeletal muscle (2) Cartilage
 (3) Connective tissue (4) Nervous tissue
40. Find out the incorrect match from the following.
 (1) Inner lining of blood vessel – Squamous epithelium.
 (2) Inner lining of fallopian tube – Ciliated epithelium
 (3) Germinal epithelium – Cuboidal epithelium
 (4) Lining of gastro-Intestinal tract – Simple cuboidal epithelium.

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

1. 3	2. 2	3. 4	4. 2	5. 1	6. 2	7. 4	8. 1	9. 3	10. 2
11. 2	12. 1	13. 4	14. 3	15. 1	16. 2	17. 4	18. 3	19. 3	20. 1
21. 2	22. 4	23. 2	24. 4	25. 1	26. 3	27. 2	28. 1	29. 3	30. 1
31. 4	32. 2	33. 4	34. 3	35. 1	36. 2	37. 3	38. 2	39. 1	40. 4

PRACTICE EXERCISE 2 (B)

1. 1	2. 2	3. 3	4. 2	5. 3	6. 1	7. 4	8. 2	9. 2	10. 3
11. 1	12. 2	13. 2	14. 1	15. 3	16. 4	17. 2	18. 1	19. 3	20. 2
21. 4	22. 4	23. 1	24. 4	25. 3	26. 2	27. 1	28. 4	29. 1	30. 3
31. 3	32. 2	33. 4	34. 1	35. 1	36. 2	37. 4	38. 1	39. 4	40. 4

Nomenclature of Plants and Animals

SYNOPSIS

- **Biodiversity** or Biological Diversity is the occurrence of various forms of living beings which differ from one another in external appearance and internal characteristics.
- About **1.7 to 1.8 million** organisms are described so far, all of which are different from one another.
- **Taxonomy/systematics** is the branch of science dealing with **identification, nomenclature** and **classification** of organisms.
- A Swedish scientist **Carolus Linnaeus** is known to be the “**father of taxonomy**”.
- He introduced the system of “**Binomial Nomenclature**”.
- The principles and criteria for assigning, scientific name to plants are provided by the **International code for Botanical Nomenclature (ICBN)**.
- For the naming of animals, taxonomist have evolved **International code for Zoological Nomenclature (ICZN)**.
- The universally accepted name of an organisms is called scientific name.
- Each scientific name has two **epithets**.
- The first part is called the **generic name** and the second part the **specific epithet**.
- The naming of an organism with two scientific names is called **Binomial Nomenclature** and is universally accepted.
- Scientific names are **Latinized** irrespective of their origin and must be printed in **Italics**. When handwritten should be **underlined** separately.
- The **genus name** must start with **capital letter** and **specific epithet** must be with **small letter**.
- The name of the scientist who first described the organism is also written in abbreviated form at the end of the biological name.
- **Classification** is the arrangement of organisms into groups and subgroups on the basis of their **similarities and dissimilarities** and placing them in a **hierarchy** that brings out their **relationships**.
- The major systems of classification are **artificial, natural** and **phylogenetic**.
- **Artificial system** of classification is based on one or few **morphological characteristics** that are helpful in easy identification of organisms.
- Earliest attempt for classification was put forth by **Aristotle** also known as **Father of Biology**, and **Father of Zoology**.
- **Theophrastus** is known as **Father of Botany**.
- They classified plants and animals based on their habit and habitat.

- **Linnaeus** proposed **two kingdom classification** in which organisms were placed under two kingdoms like **Plantae** and **Animalia**.
- **Natural system** of classification use a large number of characters showing natural relationships of organisms based on their **similarities and dissimilarities**.
- The criteria used for a hierarchical classification includes body design, anatomy, biochemistry, cytology, physiology and mode of nutrition.
- **Phylogenetic system** of classification is based on the evolutionary relationships among the organisms.

Complexity of Cell Structure

- Cells are of two types: **Prokaryotic** and **eukaryotic**
- In **prokaryotic** cells, the genetic material is **not** organized into a **nucleus** and membrane bound organelles are absent.
- In eukaryotic cells, membrane bound cell organelles and well organized nucleus are present.

Body Structure

- Organisms may be of **unicellular** and multicellular.
- In unicellular organisms, a single cell performs all the functions.
- In multicellular organism, cells are grouped together and shows the division of labour.

Mode of Nutrition

- Nutritionally organisms are of two types: **autotrophic** and **heterotrophic**.
- Autotrophic organisms can manufacture their own food.
- Heterotrophic organisms depend upon other organisms for their food and are of parasites, saprophytes etc.

Life Styles

- There are three types of life styles as **producers**, **consumers** and **decomposers**.
- Producers manufacture their own food by photosynthesis.
- Consumers are animals which feed on other organisms for obtaining food.
- Decomposers are heterotrophic organisms which feed on organic dead and decaying matters.

R.H. Whittaker (1969)

- Proposed the '**Five Kingdom Classification**'.
- *Monera*, *Protista*, *Fungi*, *Plantae* and *Animalia* are the five kingdoms.
- The kingdoms are considered on the basis of their **cell structure**, **mode** and **source of nutrition** and **body organization**, **reproduction** and **phylogeny**.

Hierarchical

- Hierarchical classification is proposed by naming the sub groups at various levels into **taxonomic categories**.
- This was introduced by **Linnaeus** and is called **Linnaean Hierarchy**.
- The following is the ascending order of Linneanean hierarchy;

Kingdom
Phylum/Division
Class
Order
Family
Genus
Species

- **Kingdom** is the **highest taxonomic** category. Each kingdom is fundamentally different from any other such category but has the same fundamental characteristics in all the organisms grouped under that kingdom.
- **Division/Phylum** is a taxonomic category which is subordinate to kingdom and higher in rank to class.
- **Class** is subordinate to division and higher than order.
- **Order** is the category lies between class and family. All the members of an order possess their own correlated characters.
- **Family** represents a group of some related genera. The category is subordinate to order.
- **Genus** is a group of related species which is subordinate to the category of family.
- **Species** is the **lowest** or the basic **taxonomic category**.
- Species is one or more **potentially interbreeding** natural populations of **morphologically similar** individuals which is **genetically distinct**.
- The hierarchical classification of human is;

Kingdom	–	Animalia
Phylum	–	Chordata
Class	–	Mammalia

Order	–	Primata
Family	–	Hominidae
Genus	–	<i>Homo</i>
Species	–	<i>sapiens</i>

Kingdom Monera

- Monera comprises of **unicellular prokaryotes**.
- They **do not possess true nucleus and membrane bound cell organelles**.
- Bacteria are the sole members of this group. They are the most abundant micro organisms.
- Bacteria are grouped under four categories based on their shape: **Coccus** (Spherical), **Bacillus** (rod shaped), **Vibrium** (comma shaped) and **Spirillum** (spiral shaped).
- Cell wall of bacteria is made up of **peptidoglycan** or **murein** layer.
- Both autotrophic and heterotrophic mode of nutrition are found in bacteria.
- Autotrophs may be **photosynthetic** or **chemosynthetic**.
- Heterotrophs may be **saprophytic** or **parasitic**.
- Heterotrophic bacteria are the most abundant in nature. Majority of them are important **decomposers**.
- Some of the bacterial members are **nitrogen fixing** organisms and take part in **ammonification, nitrification and denitrification**.
- Two important groups coming under kingdom Monera are **Archaeobacteria** and **Eubacteria**.
- **Archaeobacteria** include **ancient bacteria** belonging to **extreme environmental conditions**.
- **Halophiles** (extreme salty areas), **thermoacidophiles** (hot springs) and **methanogens** (marshy areas) belong to the group of archaeobacteria.
- **Eubacteria** include **true bacteria** which are characterized by **true cell wall** and if **motile**, flagellum/flagella present.
- **Cyanobacteria** (blue green algae) is another group of monera.
- *Anabaena*, *Nostoc* and *Oscillatoria* are blue-green algae.
- Nitrogen fixing bacterium belongs to the group chemosynthesis. E.g., *Rhizobium*.
- **Mycoplasmas** are the members which **completely lack cell wall**.
- They are the **smallest living cells** and are known as **Pleuro Peumonia Like Organisms (PPLO's)**.

- **Mycoplasmas** can **survive without oxygen** and they are **pleomorphic**.
- They are pathogenic in animals and plants.

Kingdom Protista

- It is the kingdom of **unicellular eukaryotes**.
- They possess true nucleus and membrane bound cell organelles.
- Locomotion occurs with the help of **flagella** (*Euglena*), **Cilia** (*Paramoecium*) or **Pseudopodia** (*Amoeba*).
- **Photosynthetic Protistans** possess **cell wall** (made up of silica and cellulose) where as it is **absent** in **protozoan protistans** (*Amoeba*).
- The mode of nutrition may be **photosynthetic** or **heterotrophic**.
- In *Amoeba*, the **phagocytic** method is found.
- Protistans include **photosynthetic** protistans (**Diatoms, Dinoflagellates and Euglenoids**), **saprophytic** protistans (slime moulds) and **predators** or **consumers** (**protozoans**).
- **Photosynthetic diatoms** are the **major producers of an aquatic ecosystem**.
- *Euglena* is well known for its **mixotrophic nutrition**, (**photosynthetic** as well as **saprophytic**).
- **Photosynthetic protistans** are otherwise known as **protistan algae**.
- **Slime moulds** are called as **protistan fungi** as they reproduce spores on specialised fruiting bodies similar to fungi. These **spores possess cell wall**.
- Protozoans are the **parasitic** protistans which include **Amoeboid** (*Amoeba*), **flagellated** (*Trypanosoma*), **Ciliated** (*Paramoecium*) and **Sporozoans** (Malarial parasite, *Plasmodium*).

Kingdom Fungi

- These are **heterotrophic eukaryotic** organisms which are **achlorophyllous**.
- The **fungal body** is called **mycelium** and is made of fine threads called **hyphae**.
- Fungi are multicellular and the **cell wall** is made up of **chitin**.
- Yeast is unicellular fungus.
- Fungi are heterotrophic with absorption type of nutrition.
- Most of them are **decomposers** or **saprophytes** which feed on dead and decaying matter.

- Many are **parasitic** on plants and animals.
- The **reserve food** material is **glycogen** and **oil**.
- Some fungal species are **symbiotic** (in **lichens** and **micorrhiza**).
- The association of fungi with green algae result **lichens** which are good **indicators of pollution**.
- Common examples of fungi are **Yeast** (Baker's brewing), **Mushrooms**, *Rhizopus* (bread mold) *Puccinia* (**rust fungus**), *Ustilago* (**smut fungus**) etc.
- Fungal mycelium symbiotically associated to the higher level of plants result **Mycorrhiza** and **VAM** (vesicular arbuscular micorrhiza).
- Mushrooms are edible fungus like **Agaricus** and **Pleurotus**.

Kingdom Plantae

- It includes all **eukaryotic chlorophyll containing organisms** with true **cell wall** made up of **cellulose**.
- These are multicellular in nature.
- The mode of nutrition is **autotrophic photosynthetic** due to the presence of chlorophyll bearing structures called chloroplasts.
- Few members are **partially heterotrophic** which include **parasitic forms** (*Cuscuta*) and **insectivorous plants** (**Bladderwort**, **Venus flytrap** and **Pitcher plants**).
- Another important feature of plants is the **alternation of generations**, in the life cycle, two distinct phases as the **diploid sporophyte** and the **haploid gametophyte** are seen.
- Kingdom Plantae can be subdivided into **thallophytes**, (algae) **bryophytes**, pteridophytes, **gymnosperms** and **angiosperms**.
- Thallophyta include plants with **undifferentiated body called thallus**. They are also called algae.
- The are predominantly aquatic and stored food is starch.
- Algae are of three main groups based on their pigments, **Rhodophyceae** (red algae), **Phaeophyceae** (brown) and **Chlorophyceae** (green). E.g., *Ulothrix*, *Spirogyra*, *Cladophora*, *Chara*, *Sargassum* and *Polysiphonia*.
- Bryophyta includes the **simplest land plants** which are **non-vascular plants** commonly known as **mosses** and **liver-worts**.
- They are often called the '**Amphibians of Plant Kingdom**' as they live in moist areas.
- The plant body is differentiated into root like rhizoids, leaves and stems like structures. E.g., *Riccia*, *Marchantia* (liverworts), *Funaria* (moss).
- Pteridophyta is a division of **seedless vascular plants** which are commonly called **vascular cryptogams**.
- Pteridophytes include **horsetails** and **ferns**.
- The plant body is differentiated into true **root**, **stem** and **leaves**. E.g., *Equisetum* (horse tail), *Adiantum*, (walking fern), *Marsilea* (water fern).
- Non-flowering and non-seeded plants are called **Cryptogams**.
- The plants with well differentiated reproductive tissues that produce **seeds** are called **phanerogams**.
- Phanerogams are further classified on the basis of whether the **seeds** are **naked or enclosed** in fruits as **Gymnosperms** and **Angiosperms**.
- Gymnosperms are the subdivision of seeded plants in which the **seeds are naked** and the **sporophylls** are aggregated to form **cones** and **no** formation of **flowers** and **fruits**.
- They are usually perennial, evergreen and woody trees and shrubs. E.g., *Cycas*, *Pinus*, *Cedrus* (Deodar).
- **Angiosperms** are the subdivision of seeded plants in which the seeds are produced inside the fruits and **flowers** are **formed**.
- **Angiosperms** are commonly called the **flowering plants**.
- Angiosperms are deciduous or evergreen, annuals, biennials or perennial herbs or shrubs or trees.
- Plant embryos in seeds have **cotyledons** (seed leaves).
- The angiosperms are divided into two groups on the basis of **number of cotyledons** in seeds.
- These are **monocotyledonous** and **dicotyledonous**.
- Plants with seeds having a **single cotyledon** are called **monocotyledonous**.
- Plants with seeds having **two cotyledons** are called **dicotyledonous**.
- Unique features of angiosperms are double fertilization (which involves the syngamy) and **triple fusion**.
- Double fertilization results **diploid zygote** and triple fusion results **triploid endosperm**.
- The **ovules** develop into **seeds** and the **ovaries** develop into **fruits** in angiosperms. E.g., Lily, coconut, wheat, maize, grass, bamboo, sugarcane (monocots) and pea, grams, mango, rose, (dicots).
- **Taproot system** and **reticulate venation** are the key features of **dicot plants**.

- **Firbous root system** and **parallel venation** are the distinct characters of **monocot plants**.

Kingdom Animalia

- It is a kingdom of **multicellular, heterotrophic** generally **holozoic, eukaryotes** without **cell walls**.
- Kingdom animalia contains animals ranging from **sponges** to **mammals**.
- They show **cellular, tissue, organ** and **organ system** level of organization.
- Animals are classified into **several phyla**, each having **classes, subclasses orders, families** etc., based on **body organization, symmetry, germinal layers, body cavity (coelom), endoskeleton** etc. Animals may have **cellular organization** (E.g., **sponges**), **tissue level** where cells are organized into tissues (E.g., **Coelenterata**), **organ level** where tissues form organs (E.g., **Platyhelminthes**), **organs system** level in which organs form organs system (**nematode** to **mammals**).
- Body symmetry is the similarity in the arrangement of parts. Absence of symmetry is called **asymmetry**. Symmetry may be of two types **Radial** and **Bilateral**.
- **Any vertical plane** passing through the central axis will divide the body into two equal halves in **radial symmetry** E.g., **Sponges, coelenterates** and **echinodermates**.
- Bilateral symmetry accounts the divisibility into two equal halves by **only on plane** E.g., **Platyhelminthes, Nematodes, Annelids, Arthropods, Molluscs** and **Chordates**.
- **Germinal layers** can be two or three in number as **ectoderm, mesoderm** and **endoderm**.
- Animals having **two germ layers** are **diploblastic** E.g., **Porifera** and **coelenterate**.
- Animals with **three germ layers** are **triploblastic** E.g., **Platyhelminthes** to **chordates**.
- **Coelom** is a **mesoderm lined fluid filled space** that occurs between alimentary canal and body wall. Animals may be **acoelomate, pseudocoelomate** and **coelomates** depending upon the presence and nature of coelom.
- In **acoelomates** (E.g., **Platyhelminthes**) **coelom** is **absent**.
- In **pseudocoelomates** (**Aschelminthes**) mesodermally lined **coelom** occurs as **pouches**.
- In **coelomates**, **true coelom** is present (**annelids** to **chordates**).
- Animals are grouped into **non-chordates (without notochord)** and **chordates (with notochord)** which shows the endoskeleton.

Phylum Porifera

- They are commonly called **sponges** and are mainly seen in marine and fresh water habitat.
- It includes **pore bearing organisms** with **canal system** and sedimentary habit.
- They are diploblastic and exhibits cellular level of organization.
- They have innumerable pores called **ostia** and a **single exhalent** pore called **osculum** with a cavity **spongocoel**.
- Spongocoel is lined by flagellated collar shaped cells, **choanocytes** which generates water animalcules for feeding and respiration.
- The body is covered by hard skeleton and consists of **spicules of calcium carbonate** or **silica**. E.g., *Spongilla* (fresh water sponge), *Sycon*, *Euspongia* (bath sponge), *Euplectella* (venus flower basket).

Phylum Coelenterata/Cnidaria

- It comprises of diploblastic organisms with tissue level of organization.
- All the members are aquatic and mostly marine with few of them fresh water.
- Coelenterates have a central cavity called **coelenterons** or **gastro vascular cavity**.
- They are unique in having slender, finger, like projections called **tentacles** which bears **stinging cells** called **cnidoblasts** or **nematoblasts**.
- They are radially symmetrical.
- Another unique feature exhibited by the members of this phylum is alternation of generation or **metagenesis**.
- They exists in two forms **polyps** and **medusa**. E.g., *Hydra* (fresh water polyp), *Physalia* (Portuguese man of war), *Aurelia* (jelly fish), *Adamsia* (sea-anemone), Coral etc.

Phylum Platyhelminthes

- It is the phylum of **flat worms** which are dorsiventrally flattened, triploblastic but **acoelomate** organism.
- They exhibit organ level of organization and bilateral symmetry.
- They are either **free living** (*Planaria*) **parasitic** (tape worm).

- Unique feature of the phylum is the presence of specialized **excretory cells** called **flame cells** or **protonephridia**.
- **Hooks** and **suckers** are the organs of attachment in parasitic forms. E.g., *Planaria*, *Fasciola* (liver fluke), *Taenia solium* (tapeworm).

Phylum Nematoda/Nematholminthes

- It is the phylum of **round worms/thread worms** which are triploblastic, bilaterally symmetrical, **pseudocoelomate** with primitive organ system level of organization.
- Some of the members are free living and other parasitic.
- Their body is cylindrical and elongated but unsegmented.
- They exhibit **sexual dimorphism**. E.g., *Ascaris* (common round worm), *Ancylostoma* (Hook worm), *Wuchereria* (Filarial worm causing elephantiasis).

Phylum Annelida

- The phylum consists of triploblastic bilaterally symmetrical eucoelomate animals having organs system level of organization and **metamerically segmented body**.
- The body shows similar segmental differentiation of organ.
- Annelida is a group of animals found in **diversified habitats** as fresh water, marine water as well as land. Some forms are **parasites** (*Leech*).
- Annelids are the first **animals to develop** true body cavity or **coelom**.
- The **excretory organs** are called **nephridia**.
- Body bears lateral appendages for **locomotion** in the form of **chitinous setae** or **parapodia**.
- They exhibit closed circulatory system. E.g., *Pheretima* (earth worm), *Nereis* (sandworm), *Hirudinaria* (*Leech*).

Phylum Arthropoda

- Arthropoda is the **largest phylum** of animals.
- The phylum comprises of triploblastic, bilaterally symmetrical, segmented animals having **jointed legs**, **jointed appendages** and **chitinous exoskeleton**.
- The **body cavity** is **filled with** a blood like **fluid** and is called **haemocoel**.

- Circulatory system is open type.
- Body is divisible into **head**, **thorax** and **abdomen**.
- **Respiration occurs** through **general body surface**, **gills**, **trachea** or **book lungs**.
- **Excretion** takes place by **Malpighian tubules** (insects) and **green glands** (crustaceans).
- Arthropods have **compound eyes** which enables **mosaic vision**. E.g., *Plaemon* (prawn), *Musca* (housefly), *Periplanta* (cockroach), *Cancer* (crab), *Apis* (honeybees), Spiders, Scorpion, Butterflies etc.

Phylum Mollusca

- Mollusca is the **second largest phylum** of animals
- Molluscs are **soft bodied** animals but have **shell** with calcium carbonate.
- They are triploblastic coelomates with little segmentation where the body is differentiated into **head**, **foot** and **visceral mass** covered by a special fold called **mantle**.
- They are usually bilateral symmetrical and possess **open circulatory system**.
- **Respiration** occurs by **gills** or **ctenidia**, **skin** or **mantle** or **pulmonary sac** (lungs).
- **Excretion** is brought about by one or two pairs of **sac like kidneys**.
- **Muscular foot** is present for **locomotion**. E.g., *Pila* (apple snail), *Unio* (fresh water muscle), Pearl Oyster (*Pinctada*), *Sepia* (cuttle fish), *Loligo* (squid), *Ootopus* (devil fish), snail.

Phylum Echinodermata

- It is a phylum of **spiny skinned**, triploblastic, coelomate organisms which are exclusively marine having **calcareous skeleton**, **water vascular system** and **radial symmetry**.
- They are commonly free-living organisms.
- The **adults exhibit radial symmetry** but **bilateral in larva**.
- The adults are generally **pentamerous**.
- The under surface bears a number of microscopic appendages called **tube feet** which help in **locomotion** and **gaseous exchange**.
- They have extensive **power of regeneration**. E.g., *Asterias* (star fish), *Echinus* (sea urchin), *Antedon* (feather star/sea lily), Holothurians (sea cucumber).

Phylum Hemichordata

- These animals are bilaterally symmetrical, triploblastic and have coelom.
- It consists of **worm like organism** which are marine with organ system level of organization.
- Body is divisible into three parts **proboscis**, **collar** and **trunk**.
- Circulatory system is open type.
- **Respiration** occurs through **gills** and **excretion** by **proboscis gland** E.g., *Balanoglossus*, *Saccoglossus*

Phylum Chordata

- The phylum shows triploblastic bilaterally symmetrical eucoelomate animals characterised by the presence of **dorsal hollow nerve cord**, post **anal tail**, **gill slits** and **dorsal notochord** at some stage in their life.
- Other characteristics include bilateral symmetry, organ system level organization, triploblastic, eucoelomate, closed circulatory system, well-developed excretory system, kidneys and an integumentary system.
- Phylum chordata is divided into three subphyla: **Urochordata**, **Cephalochordata** and **vertebrata**.
- Subphyla urochordata and cephalochordate are often referred to as **protochordates**.
- In **urochordata**, **notochord** is **present only in larval tail**, while in **cephalochordate** it extends from head and tail region and is **persistent through out the life**.
E.g., Urochordata – *Ascidia*, *Salpa*
Cephalochordata – *Amphioxus*
- The members of subphylum vertebrata possess notochord during the embryonic period. The notochord is replaced by a **cartilaginous** or bony **vertebral column** in the adult.
- **Vertebrates** are characterised by **ventral muscular heart** with chambers, kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.
- Vertebrata is further divided into **Agnatha** (jawless) and **Gnathostomata** (beans jaw).
- Jawed vertebrates are subdivided into super class **Pisces** (bears fins) and **Tetrapoda** (bears limbs).

Super - Class Pisces

- Pisces comprises of fishes which are exclusively aquatic animals.
- Their skin is covered with **scales** or **plates**.
- They obtain oxygen in dissolved in water by using **gills**.

- The body is streamlined and a muscular tail is used for movement.
- They are **cold blooded animals (poikilothermous)** and have a **two chambered heart**.
- They are mostly **oviparous** (egg: laying)
- Depending on the type of endoskeleton, fishes are of two class: **Chondrichthyes (cartilaginous fishes)** and **Osteichthyes (bony fishes)** E.g., Chondrichthyes includes sharks, rays and skates. *Torpedo* (electric ray), *Trygon* (stingray), *Scoliodon* (dog fish). Osteichthyes – *Exocoetus* (flying fish), *Hippocampus* (sea horse), *Anabas* (climbing perch), *Labeo* (Rohu), *Catla*.
- Super tetrapoda includes class **Amphibia**, class **Reptilian**, class **Aves** and class **Mammalian**.

Class Amphibia

- Amphibia is a class of vertebrate animals which can live in **aquatic** as well as **terrestrial habitats**.
- The body is covered with smooth skin and are **without scales**.
- It has large member of **mucous glands** which keep the skin moist.
- Amphibians are **cold blooded** animals.
- **Heart** is **three chambered**.
- Respiration takes place by **gill**, **lungs** or **skin**.
- They possess two pairs of **pentadactyl** (five digit) **limbs**, which may be absent in some cases. E.g., *Bufo* (toad), *Rana* (frog), *Hyla* (tree frog), *Salamandra* (salamander), *Ichthyophis* (limbless amphibian).

Class Reptilia

- Reptilia is the first class of terrestrial animals.
- It is a class of subphylum vertebrata in which the animals possess **dry skin** covered by epidermal **scales** or **scutes** and **incompletely four chambered heart**.
- Reptiles are creeping vertebrates.
- These animals are **cold blooded**, and breathe through **lungs**.
- Reptiles bear two pairs of pentadactyl limbs, each digit ends in claw. In snakes, limbs are absent.
- Heart is incompletely four chambered. Only **crocodiles have a four chambered heart**.
- They lay eggs (oviparous). E.g., *Hemidactylus* (wall lizard), *Testudo* (tortoise), *Naja* (cobra), *Crocodiles* (crocodile), *Chelone* (turtle), *Chameleon*, *Draco* (flying lizard).

Class Aves

- Aves is a class of **warm blooded vertebrates** having **fore limbs modified into wings**, body covered with **feathers** and **jaws modified into horny toothless beak**.
- Birds body is divided into head, neck, trunk and tail.
- Bones are very light with air spaces and are **pneumatic bones**.
- Oesophagus is modified to form **crop** and **gizzard** and meant for **storage and grinding**.
- Well developed lungs are present for respiration which have air sacs attached to them to supplement it.
- Four chambered heart.
- **Larynx is absent in birds**, instead **voice is produced by** a special organ called **syrix**.
- Sexual dimorphism is found in birds.
- All birds are **oviparous**.
- Eggs contain large amount of **yolk** and hard **calcareous shell**. E.g., *Struthio camlus* (Ostrich), *Corvus splendens* (crow), *Columba* (pigeon), *Pavo cristatus* (peacock), *Gallus* (fowl), *Bubo* (owl), *Psittacula* (parrot).

Class Mammalia

- It is a class of **warm blooded** animals with **hairy body**, tetrapod vertebrates, with **four chambered hearts**.
- They have **mammary gland** for the **production of milk** to nourish their young ones.
- The skin has hairs with **sweat** and oil **glands**.
- Fore limbs and hind limbs have **five digits** each ending with claws, **hoofs** or **nails**.
- Limbs are adapted for walking, running, swimming, flying, burrowing etc.
- Different types of **teeth (heterodont)** are present in sockets on jaws.
- Most of mammals are **viviparous** (giving birth to young ones) but rarely oviparous.
- Some are **marsupials** E.g., Kangaroo.
- Another important characteristic is the presence of **external ear** or **Pinna**. E.g., *Balaenoptera* (whale), *Macropus* (kangaroo), *Rattus* (rat), *Felis* (cat), *Canis* (dog), *Homo sapiens* (man), *Elephas* (elephant), *Pteropus* (bat), *Macaca* (monkey).
- **Oviviparous mammals** are **Ornithorhynchus** (platypus) and **Echidna** (spiny ant eater).

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The basic unit of taxonomy is
 - (1) Species
 - (2) Germs
 - (3) Kingdom
 - (4) Family
2. Binomial nomenclature is introduced by
 - (1) Aristotle
 - (2) Theophrastus
 - (3) Linnaeus
 - (4) Darwin
3. Five kingdom classification was proposed by
 - (1) Linnaeus
 - (2) Whittaker
 - (3) John Ray
 - (4) Lamarck
4. Natural system of plant classification was given by:
 - (1) Aristotle
 - (2) Linnaeus
 - (3) Bentham and Hooker
 - (4) Robert Hooke
5. Which of the following are correctly matched?
 - a. Kingdom Monera – Bacteria, cyanobacteria and Archaeobacteria
 - b. Chemosynthetic organisms – N_2 fixing, ammonifying and denitrifying bacteria
 - c. Insectivorous – *Nepenthes*, plants *Utricularia* and *Dionea*
 - d. Holozoic nutrition – Animals

The correct ones are given in

 - (1) a and b
 - (2) a, b, c and d
 - (3) b and c
 - (4) a, b and c
6. The order to which human belongs to is
 - (1) Hominidae
 - (2) Mammalia
 - (3) Chordata
 - (4) Primata
7. The correct hierarchical order of various taxons is:
 - (1) Kingdom, genus, class, phylum and division
 - (2) Phylum, kingdom, genus, species and class
 - (3) Kingdom, phylum, class, genus and species
 - (4) Phylum, division, family, genus and class
8. The cell wall of bacteria contains:
 - (1) Cellulose
 - (2) Hemicellulose
 - (3) Pectin
 - (4) Peptidoglycan
9. Appendages in bacteria which help in attachment on liquid medium are
 - (1) Fimbriae
 - (2) Flagella
 - (3) Cilia
 - (4) Mesosomes
10. The extra chromosomal genetic material seen in a bacterial cell capable of replication is called:
 - (1) Plasmid
 - (2) Mesosome
 - (3) Nucleoid
 - (4) Chromatin
11. Blue green algae belong to:
 - (1) Plantae
 - (2) Fungi
 - (3) Monera
 - (4) Protista
12. Mixotrophic (dual mode) nutrition is a characteristic of:
 - (1) *Paramoecium*
 - (2) *Amoeba*
 - (3) *Plasmodium*
 - (4) *Euglena*
13. Poached egg like minute colonies are the characteristic of:
 - (1) Viruses
 - (2) Mycoplasma
 - (3) Slime moulds
 - (4) *Penicillium*
14. Highly resistant thick walled spores produced by bacterial cells during unfavourable conditions are called
 - (1) Endospores
 - (2) Heterocyst
 - (3) Gemmules
 - (4) Zoospores
15. Diatomaceous earth is the wall deposition of
 - (1) *Chlorella*
 - (2) *Spirulina*
 - (3) Blue green algae
 - (4) Diatoms
16. Red-tide in oceans occurs due to presence and rapid growth of
 - (1) Diatoms
 - (2) Dinoflagellates
 - (3) Euglenoids
 - (4) Slime moulds
17. Protistan algae include the members like
 - (1) Diatoms
 - (2) Dinoflagellates
 - (3) Euglenoids
 - (4) All a, b and c
18. Which of the following is a parasitic protozoan?
 - (1) *Amoeba*
 - (2) *Paramoecium*
 - (3) *Plasmodium*
 - (4) *Euglena*
19. The method of sexual reproduction seen in bacteria
 - (1) Isogamy
 - (2) DNA transfer as transformation and transduction.

- (3) Spermatization
(4) Gene transfer as conjugation
- 20.** A marine protozoan that shows the bioluminescence is
(1) *Euglena* (2) *Paramoecium*
(3) *Plasmodium* (4) *Noctiluca*
- 21.** Fungi resemble animals in having
(1) Mycelium and chitin
(2) Chitin and hyphae
(3) Glycogen and starch
(4) Chitin and glycogen
- 22.** Lichens show the symbiotic association between
(1) Algae and fungi
(2) Fungi and bacteria
(3) Bacteria and virus
(4) Fungi and roots of higher plants
- 23.** The common baker's or brewer's yeast is
(1) *Neurospora* (2) *Claviceps*
(3) *Penicillium* (4) *Saccharomyces*
- 24.** Consider the following statements.
a. Agar, carrageen and algin are the products extracted from fungi.
b. Fucoxanthin, phycoerythrin and carotenoids are the colouring pigments seen in brown algae.
c. King crab, *Cycas* and *Ginkgo* are considered as living fossils.
d. Photosynthetic autotrophs, parasites, predators and consumers are present in the kingdom protista.
The two wrong statements are
(1) c and d (2) b and c
(3) a and c (4) a and b
- 25.** Select the wrongly paired one from the following.
(1) Flat worms – Tape worm and Liver fluke
(2) Sea walnuts – *Hydra* and *Obelia*
(3) Homoiothermous – Aves and mammals
(4) Incomplete – Platyhelminthes digestive system
- 26.** Select the incorrect statement from the following.
(1) *Agaricus* is an edible mushroom
(2) Toadstool and *Amanita* are poisonous mushrooms.
(3) *Puccinia* and *Ustilago* are commonly used for antibiotic production.
(4) Lichens are good indicator's of pollution.
- 27.** Which among the following produces seeds but no fruits?
(1) Thallophyta (2) Gymnosperms
(3) Bryophyta (4) Pteridophyta
- 28.** Consider the following pairs.
a. *Sequoia* – Largest tree
b. *Eucalyptus* – Tallest tree
c. *Wolffia* – Microscopic angiosperm
d. *Rafflesia* – Largest flower
The correctly paired groups are given in
(1) a, b, c and d (2) a, c and d
(3) b and c (4) a and c
- 29.** 'Amphibians' of plant kingdom are
(1) Thallophyta (2) Bryophyta
(3) Lichens (4) Rhodophyta
- 30.** Find out and select the incorrect pair from the following.
(1) Phanerogamae – Gymnosperms and angiosperms
(2) Angiosperms – Monotyledonous and dicotyledonous
(3) Cryptogamae – Bryophyta and pteridophyta
(4) Pteridophytes – Horse tails and mosses
- 31.** Plant body which is differentiated into rhizoids, leaf and stem like structures are seen in
(1) Thallophyta (2) Bryophyta
(3) Pteridophyta (4) Phanerogams
- 32.** Which of the following belongs to fish category?
(1) Star fish (2) Cuttle fish
(3) Devil fish (4) Sea horse
- 33.** Find out the false statement from the following.
(1) Platyhelminthes includes dorso - ventrally flattened, acoelomate, bilaterally symmetrical organisms.
(2) Nematelminthes comprises of round worms which are pseudocoelomate, triploblastic and have primitive organ system level of organization.
(3) Annelida consists of triploblastic, eucoelomate, metamerically segmented bilaterally symmetrical organisms with open circulatory system.
(4) Arthropoda comprises of triploblastic, bilaterally symmetrical, segmented animals with jointed appendages and chitinous exoskeleton.

34. Which among the following is exclusively marine?

- (1) Porifera (2) Mollusca
(3) Coelenterata (4) Echinodermata

35. The group to which jelly fish belongs is

- (1) Coelenterata (2) Mollusca
(3) Arthropoda (4) Pisces

36. Elephantiasis is caused by

- (1) *Ascaris* (2) *Enterobius*
(3) *Wuchereria* (4) *Ancylostoma*

37. Stinging cells or cnidoblasts are the characteristic of

- (1) Coelenterata (2) Annelida
(3) Echinodermata (4) Platyhelminthes

38. Pearl oyster belongs to the phylum

- (1) Annelida
(2) Echinodermata
(3) Arthropoda
(4) Mollusca

39. Which one of the following is not an Annelid?

- (1) *Nereis*
(2) *Pheretima*
(3) *Hirudinaria*
(4) Urchin

40. Cartilaginous endoskeleton is formed in

- (1) Shark (2) *Catla*
(3) *Hippocampus* (4) *Rohu*

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The word species was coined by:

- (1) John Ray (2) Mayr
(3) Ernst Haeckel (4) Linnaeus

2. Systematics or Taxonomy means

- (1) Identification
(2) Nomenclature
(3) Classification
(4) All 1, 2 and 3

3. Who developed the concept of phylogeny?

- (1) Linnaeus (2) Lamarck
(3) Ernst Haeckel (4) Hippiocrates

4. All the unicellular eukaryotes are grouped under the kingdom

- (1) Protista (2) Protozoa
(3) Fungi (4) Monera

5. The specialized structures in blue-green algae which fixes atmospheric nitrogen is called:

- (1) Heterocyst (2) Endospore
(3) Oospore (4) Conidiospore

7. Protistans capable of producing fruiting bodies and spores belong to

- (1) Diatoms (2) Dinoflagellates
(3) Slime moulds (4) Protozoans

8. Organism which is known as 'Slipper animalcule'

- (1) *Paramoecium* (2) *Plasmodium*
(3) *Gonyaulax* (4) *Euglena*

9. In photosynthetic bacteria, the photosynthetic pigments are seen in/as

- (1) Chloroplast (2) Grana
(3) Thylakoids (4) Chromatophore

10. Archaeobacteria which are seen at extremely high temperature and acidic pH are

- (1) Methanogens (2) Thermoacidophiles
(3) Halophiles (4) Runinant symbionts

11. Group of protistans which lack locomotory structures belongs to

- (1) Amoeboid protozoans
(2) Euglenoids
(3) Sporozoans
(4) Dinoflagellates

12. Select a binucleate cell from the following.

- (1) Dinoflagellates (2) *Paramoecium*
(3) *Amoeba* (4) Cyanobacterium

13. Choose the incorrect statement from the following.

- (1) Protista includes unicellular eukaryotic organisms.
(2) Whittaker considered cells structure, mode of nutrition for classifying organisms into five kingdoms.

- (3) Both monera and protista may be autotrophic and heterotrophic.
 (4) Monerans possess a well defined nucleus and cell wall.
14. Fungal body is generally called as
 (1) Thallus (2) Mycelium
 (3) Prothallus (4) Hyphae
15. Consider the following pairs.
 A. *Rhizopus* – Common bread mould
 B. *Spirogyra* – Pond scum
 C. Prions – Infectious RNA
 D. *Mycoplasma* – Monera
 The correctly paired ones are given in
 (1) A, B C and D (2) B, C and D
 (3) A, C and D (4) A, B and D
16. A chemical substance produced by a microorganism for inhibiting the growth of other is known as
 (1) Antibiotic (2) Antibody
 (3) Antigen (4) Aflatoxin
17. In pteridophytes, the spores are formed in specialised leaves known as
 (1) Sporophylls (2) Spikes
 (3) Inflorescence (4) Cones
18. Which of the following is wrong?
 (1) Antibiotics are extracted from certain bacteria.
 (2) *Chlorella* and *Spirulina* are widely used in space shuttles.
 (3) Kelps are the edible red algae.
 (4) *Oscillatoria* is the well known N_2 fixing blue-green alga seen in Indian paddy field.
19. Select the correct one from the following.
 (1) Vascular tissues develop first in amphibian bryophytes.
 (2) Seed formation start from the pteridophyte plants.
 (3) Thalloid mycelium and hyphae are common in green algae.
 (4) Wood of gymnosperms are durable and resistant to termites attack.
20. Xylem in Gymnosperms lacks
 (1) Vessels (2) Tracheids
 (3) Xylem parenchyma (4) Xylem fibres
21. Colouration in phaeophyceae is due to the main pigment
 (1) Carotene (2) Fucoxanthin
 (3) Phycoerythrin (4) Lycopene
22. Pick out the incorrect statement regarding angiosperms
 (1) They are the flowering plants
 (2) Unique feature of angiosperms is double fertilization.
 (3) They possess naked seeds and fruits.
 (4) The ovule develop into seeds and the ovaries develop into fruit.
23. Gymnosperms are called naked seed plants because they lack
 (1) Cotyledons (2) Endosperm
 (3) Seed coats (4) Ovary wall
24. Flame cells as excretory organ is found in
 (1) Cnidaria (2) Crustaceans
 (3) Platyhelminthes (4) Nematodes
25. Select the incorrect pair from the following.
 A. *Adamsia* – Sea anemone
 B. *Echinus* – Sea urchin
 C. *Antedon* – Sea cucumber
 D. *Cucumaria* – Sea lily
 (1) Both A and D (2) Both C and D
 (3) Both B and D (4) Both A and B
26. Locomotory organ found in earthworm is
 (1) Setae (2) Parapodia
 (3) Tube feet (4) Walking legs
27. Find out the group belonging to phylum Arthropoda?
 (1) *Periplanata*, *Musca*, *Nereis*, *Astoria*
 (2) *Pila*, *Pinctada*, *Cancer*, *Hirudinaria*
 (3) *Aurelia*, *Physalia*, *Cucumaria*, *Apis*
 (4) *Apis*, *Periplaneta*, *Palaemon*, *Musca*
28. Identify and select the limbless amphibian.
 (1) *Ichthyophis* (2) *Ichthyosarus*
 (3) *Salamandra* (4) *Naja*
29. The member of Pisces used as a biocontrol agent in mosquitoes is
 (1) *Anabas* (2) *Scoliodon*
 (3) *Gambusia* (4) *Trygon*
30. Choose the incorrect statement from the following.
 (1) Chordates are characterised by the presence of dorsal hollow nerve cord, ventral heart, post and tail and pharyngeal gill slits.

- (2) Pisces are exclusively aquatic animals with two chambered heart and are warm blooded.
- (3) Aves are warm blooded animals, egg laying with four chambered heart and lung breathers.
- (4) Reptiles are the first land animals with body showing scutes, cold blooded with incompletely four chambered heart.
31. Which of the following belong to super class Pisces?
- (1) Devil fish (2) Cuttle fish
(3) Jelly fish (4) Dog fish
32. Match the following with their common names.
- A. *Pinctada* (i) Kangaroo
B. *Macropus* (ii) Tree frog
C. *Chelone* (iii) Pearl Oyster
D. *Hyla* (iv) Ostrich
E. *Struthio* (v) Turtle
- (1) A - (iii), B - (i), C - (iv), D - (v), E - (ii)
(2) A - (v), B - (ii), C - (iv), D - (i), E - (iii)
(3) A - (iii), B - (i), C - (v), D - (ii), E - (iv)
(4) A - (v), B - (iv), C - (iii), D - (ii), E - (i)
33. Sea horse belongs to the category of
- (1) Reptilia (2) Pisces
(3) Mammalia (4) Amphibia
34. Which of the following is not a true amphibian?
- (1) Tortoise (2) Frog
(3) Salamander (4) Bufo
35. Mammals are characterized by the following features except
- (1) Presence of mammary glands
(2) Presence of external ears or pinnae
(3) Cold blooded nature
(4) Mostly viviparous
36. Sharks and rays belong to
- (2) Reptilia (2) Pisces
(3) Amphibia (4) Mammalia
37. Crop and gizzard are characteristic features of
- (1) *Balaenoptera* (2) *Draco*
(3) *Hippocampus* (4) *Struthio*
38. The voice box of birds is called as
- (1) Syrinx (2) Larynx
(3) Pharynx (4) Trachea
39. Duck billed *Platypus* and *Echidna* are
- (1) Reptiles
(2) Egg laying mammals
(3) Marsupial mammals
(4) Primates
40. Hemichordates are the connecting link between
- (1) Urochordates and cephalochordates
(2) Cephalochordates and vertebrates
(3) Urochordates and vertebrates
(4) Non-chordates and chordates

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

1. 1	2. 3	3. 2	4. 3	5. 2	6. 4	7. 3	8. 4	9. 1	10. 1
11. 3	12. 4	13. 2	14. 1	15. 4	16. 2	17. 4	18. 3	19. 2	20. 4
21. 4	22. 1	23. 4	24. 4	25. 2	26. 3	27. 2	28. 1	29. 2	30. 4
31. 2	32. 4	33. 3	34. 4	35. 1	36. 3	37. 1	38. 4	39. 4	40. 1

PRACTICE EXERCISE 3 (B)

1. 1	2. 4	3. 3	4. 1	5. 1	6. 2	7. 3	8. 1	9. 4	10. 2
11. 3	12. 2	13. 4	14. 2	15. 4	16. 1	17. 1	18. 3	19. 4	20. 1
21. 2	22. 3	23. 4	24. 3	25. 2	26. 1	27. 4	28. 1	29. 3	30. 2
31. 4	32. 3	33. 2	34. 1	35. 3	36. 2	37. 4	38. 1	39. 2	40. 4

Life Processes in Plants

SYNOPSIS

- Life processes are those **basic actions and functions** of **living beings** which are essential for their survival.

Metabolism

Metabolism is the **sum total of all biochemical reactions** in an organisms. It may be **anabolic** as **build up reactions** or **catabolic** or **breakdown reactions**.

- The life processes include **nutrition, respiration, transport, photosynthesis, growth, movements and reproduction**.
- The **branch of biology** that deals with the **study of life processes, activities and body functions** is called **Physiology**.

Nutrition

- It is a process of **obtaining and utilization of food** for meeting **various requirements** of an organisms.
- **Food is required** for providing **energy, body building, maintance and regulation** of **metabolism**.
- Two main types of nutrition are **autotrophic** and **heterotrophic**.
- **Green plants, algae and some protists** are capable of using **simple inorganic sources** like **carbon dioxide**

and **water for manufacturing food**. They are **autotrophs** and their mode of nutrition is **autotrophic**.

- **Animals, fungi, prokaryotes and protozoans** obtain complex organic food from other organisms. They are **heterotrophs** and the mode of nutrition is termed as **heterotrophic**.
- Autotrophic nutrition may be **photosynthetic** or **chemosynthetic**.
- **Chemosynthesis** involves the synthesis of organic food by break down of chemical **substances** present in the surroundings E.g., **nitrifying bacteria, sulphur bacteria and iron bacteria**.
- In **photosynthesis**, the **energy obtained** from **sunlight** is trapped with the help of chlorophyll pigments present in the chloroplast.

Photosynthesis

- It is the process of **manufacture of organic carbohydrate food** from **carbon dioxide** and **water** with the help of **solar energy** inside the chloroplast.
- $$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll 1}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2\uparrow + 6\text{H}_2\text{O}$$
 is the **balanced equation** of photosynthesis.
- In **photosynthesis**, **oxygen** is **liberated** by **photolysis** of **water**.
- **Hydrogen of water** is used to **reduce carbon dioxide** to form **carbohydrate** (glucose).

- Photosynthesis occurs in two steps as **light** and **dark reactions**.
- **Light reaction** or **photochemical phase/Hill reaction** consists of **light** driven **splitting of water** (**photolysis**), **evolution of oxygen** and formation of **assimilatory powers** like $\text{NADPH} + \text{H}^+$ and ATP .
- It occurs in **granum thylakoids** of chloroplasts.
- The **electrons released** by **photolysis of water** are accepted by **chlorophyll 'a'** molecules, later by series of electrons' movement **converts light energy** into **chemical energy**.
- **Electrons** are **transferred** into an **electron transport system** which results in the **formation of ATP** from ADP and inorganic phosphate (Pi) with the help of light energy and is called **photophosphorylation**.
- The electrons (two) ultimately reach NADP^+ (Nicotinamide Adenine Dinucleotide Phosphate) and combine with two H^+ to form $\text{NADPH} + \text{H}^+$.
- ATP and $\text{NADPH} + \text{H}^+$ together form the **assimilatory powers** and the **products of light reactions**.
- **Biosynthetic phase** or **Dark Reaction** or **Blackman's Reaction** is a light independent reaction which **requires the energy** and **reducing powers** of light reactions.
- Dark reactions occur in the **stroma** region of chloroplast.
- The dark reaction is also called **Calvin cycle** or **C_3 cycle** which initiates with **CO_2 fixation** with 5C sugar **Ribulose biphosphate** in presence of **Ribulose Biphosphate Carboxylase Oxygenase enzyme** (**RuBisCO**).
- Dark reaction results in the **formation of glucose**, which later becomes the reserve food **starch**.
- Another pathway called **C_4 pathway** or **Hatch and Slack pathway** is seen in some **tropical plants** where 3C compound **phosphoenol pyruvate** is acting as the **CO_2 acceptor**.
- In **C_3 cycle**, the **first formed stable product** is **3C-phosphoglyceric acid** (**PGA**).
- In **C_4 cycle**, the **first formed stable product** is **4C-oxaloacetic acid** (**OAA**).
- Based on the nature of CO_2 fixation, plants are classified into **C_3 plants**, **C_4 plants** and **CAM plants**.
- **CAM** (**Crassulacean Acid Metabolism**) plants, **fix CO_2 during night time**, but carries light reaction in day time.
- **C_4 cycle** is **more efficient than C_3 cycle**, because **photorespiration is absent in C_4 plants** and it is **common in C_3 plants**.

- **Maize, Pearl Millet, Amaranth, Sugar cane** etc are the examples of **C_4 plants**.
- Pineapple, *Bryophyllum* and *Kalanchoe* are the examples of **CAM plants**.

Transportation in Plants

- In plants, the **substances** that would need to be **transported** are **water**, **mineral nutrients**, **organic nutrients** and **plant growth regulators**.
- Water taken up by the roots has to reach all parts of the plant, up to the very tip of the growing stem.
- Also, the food synthesized by the leaves has also to be moved to all parts including the root tips embedded deep inside the soil.
- Over a **small distance**, **substances move** by **diffusion** or by **cytoplasmic streaming**.
- Transport over **long distances** proceeds through the **vascular system** of **xylem** and **phloem** and is called **translocation**.
- In rooted plants, the **transport in xylem** (water and minerals) is essentially **unidirectional** from roots to stem.
- Organic and mineral nutrients however undergo **multidirectional transport** from leaves to different parts of the plant through **phloem**.
- The mineral nutrients are taken up by the roots and transported upwards into the stem, leaves and growing regions.
- When any plant parts undergo **senescence**, **nutrients** may be **withdrawn** from such regions and move to growing parts
- **Short distance transport** of **water** occurs by **simple diffusion**, **osmosis** and **imbibition**.
- **Long distance transport** of **water**, **minerals** and **food** occurs generally by **mass or bulk flow system**.
- It is the **movement of substances in bulk** from one point to another as a result of **pressure difference** between two points.
- **Bulk flow** can be achieved either through a positive hydrostatic pressure gradients or a negative hydrostatic pressure gradient.
- The bulk movement of substances through the conducting or vascular tissues of plants is called **translocation**.
- Food materials are translocated from the region of their manufactured or stored area to the region of their utilization. It occurs through **phloem** tissue.

- The region of supply or storage of food is called **source** while the area of utilization is called **sink**.
- The **translocation of nutrients** include **carbohydrates, aminoacids, organic acids, hormones** and other **organic solutes**.
- The force required for translocation is provided by **companion cells** which lie adjacent to sieve tube cells of phloem.
- The entry and exit of nutrients in and from the phloem occur only by active process with ATP.
- In xylem tissue, vessels or tracheids of root, stem and leaves are interconnected to form a continuous system of water conducting channels reaching all parts of the plant.
- In the roots, cells in contact with the soil actively uptake the mineral ions by the expenditure of energy. It creates higher concentration of minerals in the root as compared to the soil solution.
- Root hair zone is the regions of water absorption.
- Due to the higher osmotic concentration inside the root, the water enters into the root from the soil and there occurs a steady movement of water into the root xylem, creating a column of water that is steadily pushed upwards. It also creates a positive pressure known as **root pressure**.
- **Ascent of sap** is the upward movement of absorbed water or sap from the root to the top of the plant.
- The mechanism of ascent of sap was explained by **Dixon and Jolly** by means of **transpiration pull** or **cohesion-tension theory**.

Transpiration

- The **loss of water** in the form of **water vapour** from the aerial parts of the plant is known as **transpiration**.
- Transpiration produces a **negative pressure** which **pulls the water** in the xylem upwards to the highest level of the plant body.
- Transpiration occurs through special leafy openings called **stomata**.
- Transpiration plays a major **driving force** in the **movement of water** in the **xylem**.

Plant Hormones or Phytohormones

- **Plant hormones** or **plant growth regulators (PGRs)** or **phytohormones** are biomolecules of diverse chemical composition.

- Based on the chemical composition these are:
 1. Indole compounds (Indole Acetic Acid) – **Auxins**
 2. Terpenes – **Gibberellic acid (GA)**
 3. Carotenoid derivatives – **Abscissic acid (ABA)**
 4. Adenine derivatives – **Cytokinins or Kinetin**
 5. Gases – **Ethylene, (C₂H₄)**
- **Auxins, cytokinins** and **gibberellins (GA)** are involved in **growth promoting activities** such as cell division, cells enlargement, flowering, fruiting etc., hence known as **growth promoters**.
- **Abscissic acid (ABA)** is involved in regulating various **growth inhibiting activities** such as dormancy and abscission.
- The **gaseous hormone, ethylene** is an inhibitor of growth activities.
- **ABA** and **ethylene** are **growth inhibitors**.

Auxins

- **Auxins** help to **initiate rooting**, promote flowering and **apical dominance** in plants.
- It also induces **parthenocarpy** and are also widely used as **herbicides**.
- E.g., **Indole Acetic Acid (IAA)**, **Indole Butyric Acid (IBA)**, **NAA (Naphthalene Acetic Acid)**, **2, 4-D (2, 4 dichlorophenoxyacetic acid)**.
- Auxins are used in tissue culture media for **root initiation** in **callus** tissue.
- **2, 4-D** is a well known **weedicide** (herbicide) and used in weed free lawns.
- **Auxins** are also found to be effective in **phototropism**.

Cytokinins

- **Cytokinins** have specific effects on **cytokinesis (cell division)** and occurs in regions where rapid cell division occurs. E.g., root apices, developing shoot buds, young fruits etc.
- They promote nutrients mobilization.
- Cytokinins play an important role in **retarding senescence**.
- It is widely used in **tissue culture** for **inducing shoot formation** in **callus** tissue. E.g., **Zeatin, kinetin**

Gibberellins

- **Gibberellins** can increase the length of axis (**internodal extension**) and results **bolting** in cabbages and many plants with **rosette habit**.

- **Seed dormancy** is **broken** by gibberellins during its **germination** by promoting various enzymes. E.g., Gibberellic acids like GA_1 , GA_2 , GA_3 etc., are identified.

Abscisic Acid (ABA)

- **Abscissic acid (ABA)** was discovered for its role in regulating **abscission** of older plant parts and dormancy of seeds.
- ABA stimulates the **closure of stomata** in the epidermis and increases the tolerance of plants to various stresses. So, it is also called the **stress hormone**.
- ABA is also known as **antitranspirant**, as it causes the **closures of stomata** and thereby **reducing transpiration**.

Ethylene

- **Ethylene** is the only **gaseous PGR**.
- It is synthesized in large amounts by tissues undergoing **senescence** and **ripening fruits**.
- It breaks seed and bud dormancy, initiates germination in seeds.
- Ethylene is commonly known as **fruit ripening hormone**.
- **Ethephon** is a main source of ethylene and is widely used in Agriculture for **latex extraction** from **rubber** and **increased production of female flowers** in cucumber plants.

- **Auxins** are known as **rooting hormone** in plants.
- **Gibberellins** are known as **internodal extension** causing (**bolting**) hormone.
- **Cytokinins** are known as **cell division promoting hormone**.
- **ABA** are known as **abscission or separation layer** causing **hormone**.
- **Ethylene** is known as **fruit ripening hormone**.

Plant Movements

- The movements in plants include **tactic** movements, **nastic** movements and **tropic** movements.
- **Tactic movements** are **locomotory movements of complete cells or organelles** in response to **external stimuli**.
- **Phototaxis**: It is the locomotion in **response to direction and intensity of light**. Microscopic **motile algae**

move **towards** area of **optimum light** and away from strong or weak light.

- **Chemotaxis**: It is the **locomotory movements in response to chemicals**. E.g., Movement of male **antherozoids** towards the **archegonium** in bryophytes.
- **Thermotaxis**: The **locomotory movement** towards **optimum temperature** and away from both high and low temperature.
- **Nastic movements** are **non-directional** movements in which the direction of response or movement is determined by the structure of the plant. **It is of photonasty, thigmonasty and seismonasty**.
- **Photonasty**: Induce **closing movement** of leaves in respond to light E.g., **sleeping tree leaves** response to light and fold at night and open during day time, and the **opening and closing of flowers** in **sunflower**.
- **Thigmonasty**: Movement in response to contact (**bending of tentacles** in **insectivorous plants**).
- **Seismonasty**: Movement in response to **shock**, contact or injury in case of sensitive plant, *Mimosa pudica*.
- **Tropic movements** are **directional** movement to the direction of stimuli.
- **Phototropism**: The directional growth of shoot to the light. Shoot system is **positively phototropic**.
- **Geotropism**: The growth caused by unilateral exposure of gravity. Primary roots are **positively geotropic**.
- **Hydrotropism**: Directional movements in **response to water**. E.g., root system shows positive hydrotropism.
- **Thigmotropism**: Tropic movement in response to the **stimulus of contact**. E.g., **coiling of tendrils and stems** around the **supporting objects**.
- **Chemotropism**: It is a directional movement that occurs in **response to a chemical stimulus**. E.g., **Growth of pollen tubes** towards the ovules seen in the ovary.

Reproduction in Gynnosperms

- Gymnosperms are **heterosporous** sporophyte hence they produce **haploid microspores** and **megaspores**.
- The two kinds of spores are produced within **sporangia** borne on **sporophylls** which are arranged spirally along an axis to form **cones** or **strobili**.
- The strobili bearing **microsporophylls** and **microsporangia** are called microsporangiate or **male strobili**.
- The **microspores** develop into a **male gametophytic generation** which is highly reduced and is called a **pollen grains**.

- The cones bearing **megasporephylls** with **ovules** or **megasporangia** are called megasporangiate or **female strobili**.
- The **male** and **female cones** are borne on **the same tree** in *Pinus* where as the cones are borne on **different trees** in *Cycas*.
- The male and female gametophytes remain within the sporangia and retained on **sporophytes**.
- Pollen grains are released from the microsporangium and carried by **air currents (wind pollination)** which come in contact with ovules on megasporophylls.
- The pollen tube carries the **male gametes** and it grows towards the **archegonia** seen in the **ovule** and discharge their contents near the mouth of archegonia and fertilization occurs.
- Zygote develops into an embryo and the **ovule** into a **naked seed**.
- **Fruit, fruit wall** and **flowers** are absent in gymnosperms.

Reproduction in Angiosperms

- In angiosperms, **flower** is the **modified shoot** showing reproductive structures in which pollen sacs and ovules develop.
- The **male reproductive organ** in a flower is **stamen** and **carpel** is the **female reproductive organ**.
- Stamen consists of a slender **filament** with an **anther** at the tip.
- Anthers contain **pollen sacs** in which **microsporogenesis** occurs for the production of **pollen grains (male gametophyte)**.
- The pollen grain on maturity shows a **vegetative cell** and a **generative cell**.
- Vegetative cell is meant for nourishment where as the **generative cell** gives rise **two male gametes** (nuclei).
- **Carpel or pistil** consists of an **ovary** enclosing one to many **ovules** and a slender **style** ends in **stigma**.
- Within the ovules there present a highly reduced **female gametophyte (embryo sac)**.
- Embryo sac formation is preceded by meiosis during megasporogenesis.
- The embryo sac has three celled **egg apparatus**, one egg cell and two **synergids**, three **antipodals** and two **polar nuclei**, totally 7-celled.
- Hence, the embryo sac is **7 celled, 8 nucleated structure**.
- Pollination is the process of transfer of pollen grains from anthers to stigma and are carried by various agents like **wind, water** or **insects**. (**Anemophily, Hydrophily** and **Entomophily** respectively)
- The pollen grains germinate on the stigma and the resulting pollen tubes grow through the stigma and style and reach the level of ovules.
- The pollen tube enters the embryo sac and discharge the two male gametes.
- One of the male gamete nucleus fuses with the egg cell to form the **zygote** by the process called **syngamy**.
- The other male gamete fuses with the **diploid secondary nucleus** to produce the **triploid primary endosperm nucleus (PEN)** by the process of **triple fusion**.
- Because of the involvement of two fertilizations, it is termed as **double fertilization**.
- The zygote develops into an **embryo** with one or two cotyledons.
- **PEN develops** into **endosperm** which provides nourishment to the developing embryo.
- The **ovules develop** into **seeds** and **ovaries** into **fruits**.
- **Double fertilization, triple fusion, flower formation** etc are the unique features of angiosperm plants.

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Gaseous exchange and water loss take place in plants through
 - (1) Guard cell (2) Stomata
 - (3) Mesophyll (4) Lenticel
2. Chemo autotrophic nutrition occurs in
 - (1) Fungi and protista
 - (2) Plants and bacteria
 - (3) Some protists and mycoplasma
 - (4) Iron, sulphur and ammonifying bacteria
3. Statements:
 - A. *Nepenthus*, *Drosera* and *Dionea* are the insectivorous plants.
 - B. *Cuscuta*, *Loranthus* and *Santalum* are root parasites.
 - C. *Rafflesia* is a saprophytic angiosperm.
 - D. Mangrove plants are seen in saline marshy lands.
 The wrong statements are
 - (1) B and C (2) A and D
 - (3) A and C (4) B and D
4. Select the incorrect statement:
 - (1) Autotrophs are capable of converting carbon dioxide and water into carbohydrates in presence of solar energy.
 - (2) Heterotrophs are organisms that do not synthesize their own food.
 - (3) Chemosynthesis involves the synthesis of organic food by oxidation of substances of chemical compounds.
 - (4) Autotrophs are occupying the second trophic level in food chain.
5. Which of the following is an anabolic process?
 - (1) Respiration
 - (2) Digestion
 - (3) Photosynthesis
 - (4) Translocation
6. Light reaction of photosynthesis occurs in
 - (1) Stroma
 - (2) Tylakoids of granum
 - (3) Matrix
 - (4) Chloroplast membrane

7. Photophosphorylation results in the formation of
 - (1) ATP (2) NADPH + H⁺
 - (3) C₆H₁₂O₆ (4) Glucose
8. Consider the following.
 - a. RuBisCO enzyme shows carboxylation and oxygenation properties.
 - b. Transpiration pull is responsible for the ascent of sap in plants.
 - c. Mineral ions are absorbed by active mechanism in plants.
 - d. Stomatal opening-closing are facilitated by mineral nutrient K⁺.
 The correct statements are given in
 - (1) a, c and d (2) b, c and d
 - (3) a and d (4) a, b, c and d
9. Photosynthetic pathway which occurs in tropical grass plants is
 - (1) Hill's Reaction (2) Calvin Cycle
 - (3) Blackman's reaction (4) Hatch and Slack cycle
10. Specialized epidermal cells seen around the stomata are
 - (1) Lenticels (2) Bulliform cells
 - (3) Guard cells (4) Subsidiary cells
11. Choose the event that does not occur in photosynthesis.
 - (1) Absorption of light energy by chlorophyll.
 - (2) Reduction of CO₂ into carbohydrates.
 - (3) Conversion of light energy in to chemical energy.
 - (4) Oxidation of carbon to CO₂.
12. Transport of water and minerals in long distances in plants is known as:
 - (1) Transpiration (2) Translocation
 - (3) Guttation (4) Photorespiration
13. The tissue which transports the products of photosynthesis in plants is
 - (1) Xylem (2) Lenticel
 - (3) Mesophyll (4) Phloem
14. The pigment present universally in all green oxygenic autotrophic plants is:
 - (1) Chlorophyll a (2) Chlorophyll b
 - (3) Chlorophyll c (4) Chlorophyll d

- 15.** Carbon dioxide fixation is associated to
 (1) Krebs cycle (2) Glycolysis
 (3) Calvin cycle (4) Photorespiration
- 16.** Thylakoids possess photosynthetic units called
 (1) Photo systems
 (2) Electron transport system
 (3) Photolysis complex
 (4) Photophosphorylation complex
- 17.** Select the wrongly matched one.
 (1) Core element of – Magnesium chlorophyll
 (2) Initial carbon acceptor – Phosphoenol in C₄ cycle pyruvate
 (3) Photorespiration – C₄ cycle
 (4) Passive mechanism – Water absorption by roots
- 18.** The enzyme RuBisCO is located inside
 (1) Peroxisomes (2) Mitochondria
 (3) Golgi bodies (4) Chloroplasts
- 19.** The common translocated form of carbohydrate is
 (1) Glucose (2) Sucrose
 (3) Starch (4) Glycogen
- 20.** Transpiration is a useful process as it involved in
 (1) Loss of water
 (2) Food translocation
 (3) Ascent of water and minerals and reduce the impact of temperature on plants.
 (4) Growth and curvature of plants.
- 21.** Stomata open at night and close during daytime in
 (1) Succulent CAM plants
 (2) Hydrophytes
 (3) Halophytes
 (4) Mesophytes
- 22.** Statements.
 1. Dixon - Jolly proposed cohesion - tension theory for ascent of sap in plants.
 2. Root pressure accounts in ascent of sap in small plants.
 3. Food (solutes) translocation is a bidirectional movement mechanism.
 4. Imbibition plays an important role in seed germination.
 The correct statement are grouped in
 (1) 3 and 4 (2) 1 and 4
 (3) 1, 2 and 3 (4) 1, 2, 3 and 4
- 23.** The herbicidal property is shown by
 (1) IAA (2) 2, 4D
 (3) NAA (4) GA₃
- 24.** Choose the incorrectly paired one from the following.
 (1) Light reactions – ATP, NADPH + H⁺ and glucose
 (2) Pressure flow – Phloem transportation theory
 (3) N₂-fixing bacteria – Symbiotic heterotrophic
 (4) C₃-plants – Less efficient in photosynthesis due to photorespiration.
- 25.** Match the following and select the right option:
 A. Cytokinin (i) Ethylene
 B. Bolting hormone (ii) Zeatin
 C. Synthetic hormone (iii) Gibberellic acid
 D. Stress Hormone (iv) NAA
 E. Ageing in plants (v) Abscissic acid
 (1) A - (ii), B - (iii), C - (v), D - (iv), E - (i)
 (2) A - (iv), B - (ii), C - (iii), D - (i), E - (v)
 (3) A - (ii), B - (iii), C - (iv), D - (v), E - (i)
 (4) A - (iii), B - (ii), C - (iv), D - (v), E - (i)
- 26.** Development of fruit without fertilization is known as
 (1) Parthenogenesis (2) Parthenocarp
 (3) Apogamy (4) Syngamy
- 27.** The curving of tentacles in insectivorous plants due to the association of insects is known as
 (1) Seismonastic (2) Thigmotropic
 (3) Thigmonastic (4) Photonastic
- 28.** Which phytohormone is generally used in tissue culture for establishing roots in callus?
 (1) Cytokinins (2) Auxins
 (3) Gibberellins (4) Abscissic acid
- 29.** Degrading yeast DNA and fruit juices contain the plant hormone _____.
 (1) Auxins (2) Ethylene
 (3) Gibberellins (4) Cytokinins
- 30.** Consider the statements A-D.
 A. Ethephon is widely used in Agriculture for the source of ethylene.
 B. Auxin stimulates the stem to bent towards the source of light.

- C. Abscissic acids are produced in mature leaves and transported to other plant parts.
 D. Gibberellins promote the growth of plumule and radicle in seed germination.

The correct statements are given in

- (1) A, B and C (2) A, C and D
 (3) A, B and D (4) B, C and D

31. Naked ovules and seeds are seen in

- (1) Mango (2) Banana
 (3) Cashew nut (4) Cycas

32. Which one of the following is not correct about pollen grains?

- (1) Male gametophyte
 (2) Exine and intine wall layers
 (3) Generative nucleus as gamete
 (4) Pollen tube from the intine wall layer.

33. The fusion product of two polar nuclei and a male gamete is:

- (1) Secondary nucleus
 (2) Primary endosperm nucleus
 (3) Vegetative cell
 (4) Zygote

34. Select the one which is wrongly paired.

- (1) Wind pollination – Anemophily
 (2) Embryo – Resultant and developing product of syngamy
 (3) Egg apparatus – Egg cell and synergids
 (4) Embryo sac – 8 celled and 7 nucleated

35. In a fertilized ovule n , $2n$ and $3n$ conditions occur respectively in

- (1) Antipodals, Egg and Endosperm nucleus
 (2) Endosperm, Egg and Antipodals

- (3) Nucellus, Endosperm and Egg
 (4) Antipodals, Synergids and Nucellus

36. One of the most resistant biological material is

- (1) Lignin (2) Cellulose
 (3) Sporopollenin (4) Hemicellulose

37. The most widely using artificial plant hormone for controlling weeds is

- (1) NAA (2) 2, 4-D
 (3) IBA (4) Ethephon

38. Which one is wrong statement?

- (1) Leghaemoglobin plays an important role in N_2 -fixing bacteria.
 (2) Plants absorb nitrate ions and converts it into N_2 for amino acid synthesis.
 (3) The cell organelle peroxisome plays an important role in photorespiration.
 (4) Phosphoenol pyruvate carboxylase (PEP case) is the enzyme involved in C_4 cycle.

39. Choose the wrong one from the following pairs, with respect to the post-fertilization changes.

- (1) Ovary wall – Fruit wall
 (2) Ovules – Seed
 (3) PEN (primary endosperm – Zygote and nucleus) embryo
 (4) Ovary – Fruits

40. Stomatal opening and CO_2 fixation take place in the night in

- (1) Pearl millet, Sunflower and Pineapple
 (2) Cactus, *Agave* and Amaranth
 (3) Mustard, *Maize* and *Bryophyllum*
 (4) *Kalanchoe*, *Bryophyllum* and Pineapple

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Oxygen released during photosynthesis comes from:

- (1) Water
 (2) Carbon dioxide
 (3) Chloroplast
 (4) Chlorophyll

2. The dark reactions of photosynthesis occur in

- (1) Thylakoid (2) Grana
 (3) Inner membrane (4) Stroma

3. The opening and closing of the stomatal pore depend upon:

- (1) Oxygen (2) Wind velocity
 (3) Water in guard cells (4) CO_2 concentration

4. The first event in photosynthesis is
 - (1) Formation of ATP
 - (2) Absorption of light energy and loss of electrons from chlorophyll.
 - (3) Splitting of water
 - (4) Reaction of CO_2 with RuBP
5. Light reaction of photosynthesis result the products like
 - (1) Starch and molecular O_2
 - (2) ATP, NADPH + H^+ and electrons
 - (3) ATP, NADPH + H^+ and molecular O_2
 - (4) Glucose and molecular O_2
6. Select the wrongly paired one from the following.
 - (1) Companion – Helps in the cells translocation of phloem
 - (2) Antitranspirants – PMA, high concentration of CO_2 and ABA which promote transpiration.
 - (3) Mineral nutrient N_2 – Available in both inorganic and organic forms to plants.
 - (4) Photosynthetically – 400-700 of active radiation (PAR) sunlight.
7. Photosynthesis is maximum in the region of visible light
 - (1) Violet-Blue and Red
 - (2) Orange and red
 - (3) Green and red
 - (4) Violet and green
8. The source of hydrogen for carbon assimilation is derived from.
 - (1) FADH_2
 - (2) Chlorophyll
 - (3) RuBP
 - (4) NADPH
9. Loss of water from the plant in the form of droplets is called:
 - (1) Transpiration
 - (2) Guttation
 - (3) Evaporation
 - (4) Respiration
10. Tracheary elements are involved in
 - (1) Mechanical strength
 - (2) Food translocation
 - (3) Conduction of minerals
 - (4) Both 1 and 3 together
11. Ascent of sap means
 - (1) Upward movement of water and minerals in plants
 - (2) Downward movement of organic nutrients.
 - (3) Movement of contents in a vacuole
 - (4) Upward and downward movement of food materials.
12. Consider the following pairs.
 1. Oxaloacetic acid – First stable product of C_4 cycle
 2. Ribulose biphosphate – Initial CO_2 acceptor in sugar cane plant.
 3. Mesophyll of plants – Site of both light and C_3 dark reactions
 4. Mesophyll of plants – Site of Calvin cycle C_4 plants

The two wrongly paired one are given in

 - (1) 1 and 3
 - (2) 1 and 4
 - (3) 2 and 2
 - (4) 2 and 4
13. Fruits ripening is promoted by the plant hormone
 - (1) Ethylene
 - (2) Carbamide
 - (3) Zeatin
 - (4) 2, 4-D
14. Common inhibitor of seed germination is
 - (1) Gibberellic Acid
 - (2) ABA
 - (3) Ethylene
 - (4) Auxins
15. Which is the hormone responsible for apical dominant growth?
 - (1) Abscissic acid
 - (2) Gibberellins
 - (3) Kinetin
 - (4) Auxins
16. Chemically, cytokinins are related to
 - (1) Carotenoid
 - (2) Terpenes
 - (3) Aminopurines
 - (4) Indole
17. The movement of motile algae towards the region of optimum light is called.
 - (1) Phototropic
 - (2) Phototaxis
 - (3) Photonasty
 - (4) Photosynthetic
18. Highly reduced female gametophyte of angiosperm:
 - (1) Ovary
 - (2) Embryo sac
 - (3) Egg cell
 - (4) Synergids
19. On touching the leaves of *Mimosa pudica*, drooping down of leaves occur because of
 - (1) Seismonasty
 - (2) Nyctinasty
 - (3) Chemonasty
 - (4) Thigmotropism
20. Thigmotropism is best seen in the
 - (1) Root apex growth
 - (2) Stem apex growth
 - (3) Tendrils coiling
 - (4) Leaf unfolding

21. The phytohormone involved in phototropism is
 (1) Gibberellin (2) Kinetin
 (3) 2, 4-D (4) IAA
22. Double fertilization and triple fusion are common in
 (1) Gymnosperms (2) Pteridophytes
 (3) Angiosperm (4) Bryophytes
23. In a flower, the male gametes are formed from
 (1) Vegetative nucleus
 (2) Generative nucleus
 (3) Primary endosperm nucleus
 (4) Synergid nucleus
24. Select the correct pair of statements:
 A. Flowers are said to be unisexual when it contains either stamens or carpels.
 B. Flowers are said to be bisexual when both stamens or carpels are present.
 C. If the transfer of pollen occurs in the same flower, it is referred to as cross pollination.
 D. If the pollen is transferred from one flower to another, it is known as self pollination.
 (1) A and B (2) C and D
 (3) A and C (4) B and D
25. *Bryophyllum* plant is vegetatively propagated by
 (1) Underground stem tuber
 (2) Leaf buds
 (3) Underground root tuber
 (4) Stolon and rhizome
26. The part of the seed which later develops into shoot during its germination is
 (1) Cotyledons (2) Endosperm
 (3) Radicle (4) Plumule
27. Select the incorrect statement from the following.
 (1) Phytohormone ethylene is produced in roots and diffuse to other plant parts.
 (2) Abscissic acid is produced in immature fruits and transported to other plant parts.
 (3) Auxins are generally produced in germinating seeds, tips of stem and roots, leaves and leaf bud.
 (4) Cytokinins are produced at the tip of the root and transport through the xylem to different parts of the plant.
28. Consider the statements A-D.
 A. Secondary nucleus of embryo sac fuses with a male gametic nucleus and results triple fusion.
 B. Synergid directs the pollen tube growth and receives male gametes during fertilization.
 C. Diploid zygote and triploid PEN are the products of triple fusion.
 D. Microsporogenesis results two male gametic nuclei in the pollen grains.
 The correct and wrong statements together are
 (1) A and C are correct; B and D are wrong
 (2) A and D are correct; B and C are wrong
 (3) A and B are correct; C and D are wrong
 (4) C and D are correct; A and B are wrong
29. Choose the correctly matched pair from the following.
 (1) Indole butyric acid – Used to prevent sprouting of potatoes and drooping of premature fruits.
 (2) Ethephon – Used to increase latex production in rubber.
 (3) Naphthalene acetic acid – Used to sprout root on stem and to induce fruiting
 (4) 2, 4-D – Used to prevent early flowering and ripening of fruits
30. Which of the following commercial application of phytohormones are correct?
 a. Auxins are extensively used in agriculture to promote flowering in pineapples.
 b. Ethephon is used for promoting female flowers in cucumbers, thereby increase the yield.
 c. Ethylene is of great use in ripening the fruits like mango, orange, pineapple etc.
 d. Cytokinins are used for keeping freshness in leafy and green vegetables.
 The correct ones are given in
 (1) a, b and c (2) b, c and d
 (3) a, c and d (4) a, b, c and d
31. Which one is wrong about photosynthesis?
 (1) 30 ATP and 18 NADPH + H⁺ are needed for C₃ and C₄ cycles.
 (2) Water provides source of hydrogen for CO₂ reduction and evolution of molecular oxygen.
 (3) Light and light reaction products are necessary for dark reactions.
 (4) Oxygenase property of RuBisCO is the reason for photorespiration in C₃ plants.
32. If a horticulturist used gibberellins in a dwarf plant during its vegetative growth phase, then which of the following are correct?

- A. It results excess growth of stem resulting tall and vine like plant.
- B. It affects only the physical feature, but not changing its genetic nature.
- C. The next generation obtained from such a modified plant will be of tall and vine like.
- D. It induces early maturation of fruits.

The correct ones are given in

- (1) C and D
- (2) A and B
- (3) A and C
- (4) B and D

33. The wrong statement from the following is

- (1) Cuscuta plant derive the organic nutrients from the phloem and xylem of host plant.
- (2) Melvin Calvin and Andy Benson discovered the mechanism of CO_2 fixation in green plants.
- (3) Compensation point means the rate of photosynthesis and the rate of respiration are equal at certain time in plants.
- (4) Thylakoids are seen in granum and are the ultimate site of light reactions.

34. Select the correct ones from the following.

- A. Electrons are emitted from the light absorbed chlorophyll molecules.
- B. Excited and expelled electrons undergo movement and results the synthesis of ATP and the formation of $\text{NADPH} + \text{H}^+$.
- C. Blue and red regions of the solar spectrum are responsible for photosynthetic dark reactions.
- D. Green light spectrum plays major role in light reactions of photosynthesis.

The correct statements together are

- (1) A and B (2) A and C
- (3) B and D (4) A and D

35. Consider the reactions $\text{H}_2\text{O} \longrightarrow 2\text{H}^+ + \frac{1}{2}\text{O}_2 + 2\text{e}^-$ and this equation accounts

- (1) Photo excitation of electrons
- (2) Photosynthetic reactions
- (3) Enzymatic activity of RuBisCO
- (4) Photolysis of water in light reaction

36. Which of the following pairs are correctly matched?

- a. *Spirogyra* – Fragmentation
- b. Hydra, Planaria – Regeneration and sponges

- c. Scion – The part of the plant that is grafted on to other plant
- d. Parthenogenesis – Development of organisms from an unfertilized egg

The correctly paired ones are given in

- (1) a, c and d
- (2) a, b, c and d
- (3) b, c and d
- (4) a, b and d

37. Match the contents of column I with column II.

Column I	Column II
A. Megasporophyll	(i) Pollen grains
B. Male gametophyte	(ii) Embryo
C. Female gametophyte	(iii) Primary endosperm nucleus
D. Triple fusion	(iv) Female strobili
E. Syngamy	(v) Embryo sac
(1) A - (i), B - (ii), C - (iii), D - (iv), E - (v)	
(2) A - (i), B - (iv), C - (v), D - (ii), E - (iii)	
(3) A - (iv), B - (i), C - (ii), D - (v), E - (iii)	
(4) A - (iv), B - (i), C - (v), D - (iii), E - (ii)	

38. Select the incorrect statement with respect to vegetative propagation.

- (1) Banana is multiplied by means of rhizome.
- (2) Bulbils are the vegetative propagules seen in Agave.
- (3) Potato is propagated by means of bulbs.
- (4) Aquatic plants are multiplied by offsets.

39. Consider the statements A–D.

- A. Production of plants in an artificial synthetic medium is known as micro propagation.
- B. Callus is the cellular mass of tissue developed in the early stage of tissue culture.
- C. Orchids, Dahlia and Carnation plants are raised by means of micropropagation.
- D. Air layering (gootee) is practiced in grape, rose, raspberry and strawberry plants.

The correct statements are given in

- (1) Statements A, B and C
- (2) Statements A and B
- (3) Statements B, C and D
- (4) Statements A, B, C and D

40. Choose the incorrect statement(s):

- A. Dark reaction of photosynthesis initiates by the fixation of CO_2 with Ribulose biphosphate and

results in the formation of 3C compound and finally into 6C glucose.

- B. Organic and mineral nutrients undergo multi-directional transport from leaves to different parts of the plant.
- C. Nastic movements are directional movement in which the direction of response is determined by plant structure.

- D. In gymnosperms, the male and female gametophytes are released from the sporophytes for fertilization.

The incorrect ones are grouped in

- (1) A and D
- (2) C only
- (3) C and D
- (4) A and B

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

1. 2	2. 4	3. 1	4. 4	5. 3	6. 2	7. 1	8. 4	9. 4	10. 3
11. 4	12. 2	13. 4	14. 1	15. 3	16. 1	17. 3	18. 4	19. 2	20. 3
21. 1	22. 4	23. 2	24. 1	25. 3	26. 2	27. 3	28. 2	29. 4	30. 1
31. 4	32. 3	33. 2	34. 4	35. 1	36. 3	37. 2	38. 2	39. 3	40. 4

PRACTICE EXERCISE 4 (B)

1. 1	2. 4	3. 3	4. 2	5. 3	6. 2	7. 1	8. 4	9. 2	10. 4
11. 1	12. 4	13. 1	14. 2	15. 4	16. 3	17. 2	18. 2	19. 1	20. 3
21. 4	22. 3	23. 2	24. 1	25. 2	26. 4	27. 2	28. 3	29. 2	30. 4
31. 1	32. 2	33. 3	34. 1	35. 4	36. 2	37. 4	38. 3	39. 1	40. 3

Life Processes in Animals

SYNOPSIS

- Nutrition, digestion, respiration, gas exchange, circulation, excretion etc., are the various life processes seen in animals.

Nutrition in Animals

- Animals are multicellular eukaryotes with most complex level of organization.
- They are **heterotrophic** and incapable of synthesizing their own food.
- In **single celled organisms**, the food may be taken in by the entire surface as **ingestion**. E.g., In *Amoeba* it takes in food using temporary finger like extensions of the cell surface called *Pseudopodia* which fuse over the food particle forming a **food vacuole**.
- In *Paramoecium*, the food is taken into body by means of the movement of *Cilia* which cover the entire surface of the cell.
- Protozoans carry out **holozoic** nutrition through intracellular digestion.
- Human beings are omnivorous that means both **herbivore** and **carnivore** in habit.

Digestion in Animals

- Digestive system is group of organs and associated digestive gland which take part in the **intake of food, digestion, absorption** and **removal of undigested matters (faecal)**.
- The digestive system forms a continuous canal called **alimentary canal** extending from the mouth to the anus.
- Alimentary canal consists of **mouth, buccal cavity, esophagus, stomach, small intestine, large intestine** and **anus**.
- Mouth leads into the **buccal cavity** which has a number of **teeth** and a **muscular tongue**.
- Teeth are **embedded** in **sockets of jaw**, hence called **thecodont**.
- Due to the presence of two sets of teeth as **temporary or deciduous teeth** and **permanent teeth**, the type of dentition is called **diphyodont**.
- An adult human has **32 permanent teeth** which are four different types as **Incisors, Canines, Premolars** and **Molars**, hence known as **heterodont** dentition.
- The **dental formula** of a human adult is $\frac{2123}{2123}$ (each half of upper and lower jaw).

- Tooth is made up of **dentine** enclosing the pulp which is externally covered by outer shining and hardest covering called **enamel**.
- Tooth decay or dental caries causes gradual softening of enamel and dentine.
- Food particles with masses of bacterial cells stick to the teeth to form dental plaque.
- Three pairs of salivary glands are associated with buccal cavity as **sub maxillary**, **parotid** and **sublingual glands** which collectively **secrete saliva**.
- **Saliva** consists of **water**, **mucus**, **lysozyme** (anti bacterial enzyme) and **Salivary amylase** or **ptyalin** (starch degrading enzyme).
- **Pharynx** is common passage for respiratory and digestive tract which leads into **oesophagus** or **food pipe**, a muscular distensible tube.
- **Oesophagus** pushes food into the stomach by alternate contraction and expansion called **peristalsis**.
- Stomach is the widest, thickened, distensible muscular organ of the alimentary canal. It comprises three regions as **cardiac**, **fundus** and **pyloric**.
- The **stomach** contains numerous glands called **gastric glands** collectively secrete **gastric juice** which contains **HCl**, **mucus**, **enzymes**, **pepsin**, **rennin** and **gastric lipase**.
- The **hydrochloric acid** creates an **acidic medium** for the action of the enzyme pepsin.
- The mucus protects the inner lining of the stomach from the action of the acid under normal conditions.
- The digested pulpy food from stomach called **Chyme** enters into the small intestine.
- **Small intestine** is the site of **complete digestion** of carbohydrates, proteins and fats.
- It receives the secretions of the associated digestive glands **pancreas** and **liver**.
- The **acidic** chyme from stomach is **neutralized** by the **alkaline juice of pancreas**.
- **Bile juice** secreted by **liver** is stored in **gall bladder** and releases it into the **small intestine** and helps in **emulsification of fats**.
- Small intestine comprises of proximal **duodenum**, middle **jejunum** and elongated **ileum**.
- Pancreatic juice contains protein degrading enzymes, **trypsin**, **chymotrypsin** and **carboxypeptidase** and **lipase** for breakdown of fats.
- The intestinal glands secrete intestinal juice containing enzyme which converts proteins to amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol.

- The inner wall lining of small intestine has numerous finger like projections called **villi** which can increase the **surface area for absorption**.
- The digested food is completely absorbed into each and every cell of the body.
- The undigested and unabsorbed food is sent into the large intestine and moved out through the anus as faecal matter.

Respiration in Animals

- Respiration is a multi step enzyme mediated process which involves the break down of organic compounds to release energy in the form of ATP.
- The organic compounds which undergoes oxidative breakdown in respiration are called respiratory substrates.
- The common **respiratory substrate** is glucose.
- The first step is the **breakdown of glucose** into three carbon **pyruvate** occurs in the **cytoplasm** of the cells and is known as **glycolysis**.
- In **anaerobic respiration**, pyruvate gets converted into **ethanol** or lactic acid and CO_2 by the process of **fermentation**.
- Under **aerobic conditions**, pyruvate breaks down into CO_2 , **water** and **energy** and occurs in the mitochondria.
- **Anaerobic respiration** takes place in the **absence of oxygen** and **aerobic respiration** takes place in the **presence of oxygen**.
- Alcoholic fermentation is carried by yeast cells and lactic acid fermentation is common in human muscles.
- Accumulation of lactic acid in the muscles results in cramping.
- Energy rich ATP molecules are formed in cellular respiration and are used for other cellular endothermic reactions.
- In endothermic reactions, the terminal phosphate linkage of ATP is broken and releases 30.5 k J/mol energy.

Exchange of Gases in Animals

- Breathing is a physical process by which the uptake of oxygen and elimination of carbon dioxide occurs.
- In unicellular organisms like *Amoeba* and *Paramecium*, the **cell surface** itself acts as the respiratory surface. The exchange of gases occurs by the process of diffusion.
- **Cutaneous respiration through skin** occurs in **earthworm** and many amphibians including **frog**.

- In frogs, **bucco-pharyngeal** respiration also occurs.
- In **insects** and some **arthropods**, a network of tubes called **trachea** which communicates outside with **spiracles** to the environment acts as respiratory organ.
- **Branchial respiration** occurring through the respiratory organ gills are seen in several **aquatic animals** like prawn, crab and fishes.
- **Pulmonary respiration** using **lungs** is common in **amphibians, reptiles, birds and mammals**.
- The **respiratory units in lungs** are the **alveoli** or air sacs where the **exchange of gasses occurs**.
- The respiratory system comprises the respiratory tract which includes the **nostrils, nasal cavities, pharynx, trachea and bronchi** and the respiratory organ **lungs**.
- **Nostrils** are external openings which leads into **nasal cavities** from where the air pushed into the pharynx.
- Pharynx opens into a wider part of **trachea** called **larynx** or **voice box**.
- Trachea is guarded by an opening called **glottis**.
- A small cartilaginous flap called **epiglottis** covers the glottis during **swallowing of food to prevent the entry into respiratory tract**.
- **Trachea** or **wind pipe** arises from the base of larynx which are supported by C-shaped cartilages and ensures that the **air passage does not collapse**.
- Trachea divides into two **bronchi** which splits up into terminal **bronchioles** supplying the **alveoli** or **air sacs**.
- The process of breathing comprises **inhalation** and **exhalation**. The respiratory processes are supplemented by the ribs and muscular **diaphragm**.
- Exchange of gases occurs in the **alveoli** where oxygen diffuses from alveolar air to blood present in capillaries around the alveoli.
- Carbon dioxide diffuses from blood into alveolar air.
- The respiratory pigment **haemoglobin** takes up oxygen from the air in the lungs and carry it to tissues by the formation of **oxyhaemoglobin**.
- The cells intake oxygen and uses it for the oxidative breakdown of respiratory substrate.
- Carbon dioxide is produced in the process and diffuses into blood through tissue fluid.
- CO_2 binds to hemoglobin to form **carbaminohaemoglobin** and gets transported back into lungs for exchange.
- The circulatory system is made up of **tubes**, a **pumping heart** and **circulating fluids** like, **blood** and **lymph**.
- **Blood vascular system** and **lymphatic system** are the two circulatory systems.
- Blood is a connective fluid tissue aiding circulation, supplying of **nutrients** and **oxygen** to all living cells and **taking away waste products** as well as CO_2 from them.
- Blood comprises of **plasma** (55%) and **formed elements** (45%).
- **Plasma** consists of 92% water and 8% proteins.
- The important solutes include proteins (**albumin, globulin** and **fibrinogen**), nutrients, excretory products, inorganic salts, gases, hormones etc.
- Blood corpuscles are of three types: **red blood corpuscles, white blood corpuscles** and **blood platelets**. All of these are **synthesized** inside red **bone marrow**.
- RBCs are **biconcave, enucleated** (without nucleus) disc shaped cell which contains the **pigment haemoglobin**.
- The **life span** of RBC is **120 days**.
- RBCs are **destroyed** in the **spleen** and the spleen is said to be the **graveyard of RBCs**.
- **Karl Landsteiner** identified various blood groups in man.
- Blood groups are of **A, B, AB and O types**, based on the **antigens present in the red blood cells**.
- **Blood groups A** shows **antigen A** and **antibody b**, and this blood can **donate** to persons having either **A or AB blood groups**.
- **Blood group B** shows **antigen B** and **antibody a**, and this blood can **donate** to persons having either **B or AB blood group**.
- **Blood group AB** shows both **A and B antigens** and **no antibody**, and can donate to **persons having only AB blood** but can **receive from all blood groups A, B, AB and O**.
- **Blood group O** shows **no antigens** but both **a and b antibodies** hence **can donate to all blood groups A, B, AB and O** but can receive only from O group.
- Hence **AB blood group** is known as **universal recipient** and **O blood group** is known as **universal donor**.
- Blood group detection and its **matching (compatibility)** are carried during **blood transfusion** (donation).
- **Rh (Rhesus) factor** is another antigen **factor** seen on the **surface of RBC**.
- Most people are **Rh⁺** (positive), as they **possess Rh factor**.

Circulatory System

- Transportation of materials from one body part to another is carried out by **circulatory system** in animals.

- Those people who **lack Rh factor** are known as **Rh^{-ve} (negative)**.
- If an **Rh^{-ve} pregnant woman** carrying an **Rh^{+ve} baby**, **anti Rh-antibodies** develop in her blood. This will result in the **interactions of Rh^{+ve} antigen** of the baby and **Rh^{+ve} antibodies** prepared by the mother and causes **anaemia** or **agglutination** leading to **death of baby** (**Erythroblastosis foetalis**).
- **WBC** are colourless, **nucleated**, blood corpuscles with a **life span** ranging from **12 hours** to **several days**.
- White blood corpuscles are of two types: **granulocytes** and **agranulocytes**.
- **Granulocytes** possess **large sized granules** in the **cytoplasm** and their **nucleus is lobed**.
- Granulocytes include **basophils**, **eosinophils** and **neutrophils**.
- **Agranulocytes** are **devoid of granules** and include **monocytes** and **lymphocytes**
- These cells form the **basis of immunity**.
- **Blood platelets** or **thrombocytes** are colourless **non-nucleated cells** with a **life span** of **7-10 days**.
- **Blood platelets** help in **blood clotting** or **coagulation**.
- **Plasma without clotting factors** is called **serum**.
- **Blood vessels** in animals include **arteries**, **veins** and **capillaries**.
- **Calcium ions**, **blood platelets**, **prothrombin**, **thrombin** and **fibrin** are the factors essential for **blood clot**.
- Injured tissues and blood platelets together result the release of **thromboplastin**.
- Thromboplastin converts **prothrombin** into **thrombin**.
- Thrombin converts **fibrinogen** into **fibrin**.
- Fibrin and **red blood corpuscles** result **blood clot**.
- **Arteries** are blood vessels **distributing blood from the heart to various organs** of the body and generally **carries oxygenated blood**. **Pulmonary artery is the only artery carrying deoxygenated blood**.
- **Veins** are collecting blood vessels which **carry deoxygenated blood** from various parts of the body **towards the heart**.
- **Pulmonary vein** is the only one blood vessel carrying **oxygenated blood** from lungs to heart.
- **Capillaries** are very **narrow blood vessels** which are **formed by the network inside the body organs**.
- Blood circulation is said to be **double circulation** as the **deoxygenated blood** from various body parts **reaches the heart** and **goes to the lungs** thereafter, the **heart** receives **oxygenated blood from the lungs** and pumped into various parts of the body.
- **Heart** is the **central organ of blood vascular system** and made up of **cardiac muscles**.
- It lies in thoracic cavity between the lungs.
- Heart is enclosed in a fluid filled **membranous sac** called **pericardium**.
- **Mammalian heart** is **four chambered** with **two auricles** and **two ventricles**.
- Right auricle opens into right ventricle through an aperture guarded by **tricuspid value**.
- The left auricle opens into left ventricle through an aperture guarded by **bicuspid or mitral valve**.
- These **valves** are **supported by fine fibres** called **chordae tendinae**.
- Right ventricle opens into a **pulmonary arch** and left ventricle opens into **aorta** and both these openings are guarded by **semi-lunar valves**.
- **Deoxygenated blood** from the whole body enters right auricle through **superior venecava** and **inferior venecava**.
- The **rhythmic expansion** and **contraction of heart** is called **heart beat**.
- The **expansion** is called **diastole** while the **contraction** is known as **systole**.
- The **force that blood exerts against the wall of a vessel** is called **blood pressure**. This pressure is much greater in arteries than in veins.
- The **pressure of blood inside the artery** during **ventricular systole** (contraction) is called **systolic pressure** and pressure during **ventricular diastole** (relaxation) is called **diastolic pressure**.
- The normal **systolic pressure** is about **120 mm Hg** and **diastolic pressure** is **80 mm of Hg**. (120/80 mm Hg).
- Blood pressure is measured with an instrument called **Sphygmomanometer**.
- High pressure is called **hypertension** and is caused by the constriction of arterioles, which results in increased resistance to blood flow. It can lead to the rupture of artery and internal bleeding.
- **Lymph** is another type of fluid involved in transportation. This is also called **tissue fluid**.
- **Lymph does not contain RBCs** and **blood platelets** but **only lymphocytes**.
- **Lymph functions** as a **middle man** that **exchanges materials** between **blood** and **tissue fluids**.
- Lymph is formed inside fine blind tubes called **lymph capillaries** which joins to form **lymph nodes** or **lymph glands**, which are the **seats of lymphocyte maturation**.

- **Lymph** also carries digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into the blood.

Excretion in Animals

- **Excretion** is the biological process of removal of nitrogenous waste materials from the body.
- A process related to excretion is **osmoregulation** which involves the regulation of osmotic pressure of body fluids by controlling the amount of water and salts in the body.
- The waste products include **nitrogenous waste products** (urea, uric acid, ammonia, creatine, creatinine), excess **chemicals** (drugs, pigments, hormones, vitamins), **bile pigments**, CO_2 and excess water.
- **Excretion in unicellular organisms** like *Amoeba*, *Paramoecium* is carried by **contractile vacuole** which serves in **osmoregulation** also.
- In **Sponges**, wastes diffuse out through the **osculum openings** seen on the body surface.
- In cnidaria like *Hydra*, wastes diffuses out through the **oral opening**.
- **Flame cells** are excretory organ in flatworms, **nephridia** in earthworms, **green glands** in crustaceans like prawns **malpighian tubules** in insects and **kidneys** in molluscs.
- **Kidneys** form the excretory organ in vertebrates.
- The excretory system comprises a pair of **ureters**, a **urinary bladder** and a **urethra** in addition to pair of kidneys.
- **Structural and functional unit of kidneys** are **nephrons (uriniferous tubules)**.
- A nephron consists of two parts as **Malpighian body** and **renal tubule**.
- The malpighian body comprises of **Bowman's capsule** and a bunch of fine blood vessels or capillaries called **glomerulus**.
- Renal tubule has three parts, **proximal convoluted tubule (PCT)**, **loop of Henle** and **distal convoluted tubule (DCT)**.
- DCT opens into a **collecting tube (CT)** which opens into the **pelvis** leading into ureter.
- Renal tubules are covered by a network of capillaries called *vasa recta*.
- The mechanism of urine formation, involves **glomerular filtration**, selective **reabsorption** and **tubular secretion**.
- The glomerular filtration occurs by **ultrafiltration** under pressure and results in the formation of **glomerular nephric filtrate**.
- The useful substances in the filtrate is reabsorbed which includes glucose, aminoacids salt and major amount of water.
- **Concentration of urine occurs in collecting tube** in the presence of hormone called **anti-diuretic hormone (ADH)** or **vasopressin**.
- Urinary bladder is a distensible sac for storage of urine and urethra is a tube that takes urine to out side.
- **Total amount of urine excreted per day** is about **1.6 to 1.8 litres**.
- **Urine** contains **96% water**, **2.5% organic** substances and **1.5% inorganic solutes**.
- **Accessory excretory organs** include **skin, liver, lungs, large intestine** etc also play an important role in excretion.
- **Haemodialysis** is a technique used for the **removal of nitrogenous waste products** from the **blood** when the **kidneys** are **non-functional** due to an injury or infection.

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the statements.

- A. Almost all animals are coming either herbivores or carnivores category.
- B. Human beings, rats, crow etc., are omnivorous.
- C. Holozoic mode of nutrition is seen in *Amoeba* and *Paramoecium*.
- D. Lysosome involved in the digestion of engulfed food is seen in the contractile vacuole of *Amoeba*.

The correct statements together are given in

- (1) A, C and D
- (2) A, B and C
- (3) A and D
- (4) A, B, C and D

2. The function of gizzard seen in grasshopper and cockroach digestive system is

- (1) Removal of excretory products
- (2) Storage of food materials
- (3) Grinding of food materials
- (4) Secretion of digestive enzymes

3. Select the wrongly paired one from the following.

- (1) Hepatic caecae – Excretion
- (2) Crop in grasshopper – Temporary storage of food
- (3) Blood of grasshopper – Haemolymph
- (4) Egestion – Removal of undigested food from the body.

4. Digestive enzymes in grasshopper and cockroach are secreted from

- (1) Foregut (2) Midgut
- (3) Hind gut (4) Hepatic caecae

5. The various kinds of teeth present in human beings are

- (1) Premolars and canines
- (2) Molars and incisors
- (3) Muscular pharynx and molars
- (4) Incisors, canines, premolars and molars.

6. The first stage of digestion in human beings takes place in

- (1) Oesophagus (2) Small intestine
- (3) Buccal cavity (4) Stomach

7. Statements A, B, C and D.

- A. The digestion of starch (carbohydrate) begins in the buccal cavity by ptyalin enzyme.
- B. Protein digestion begins in the stomach.
- C. Gastric lipase enzyme completely breaks down the lipids.
- D. Hydrochloric acid, proteins digesting enzymes and mucus are present in the gastric juice.

The correct and wrong statements are given in

- (1) A, C and D are correct; while B is wrong
- (2) A, B and D are correct; while C is wrong
- (3) B, C and D are correct; while A is wrong
- (4) A, B and C are correct; while D is wrong

8. Select the incorrectly matched groups from the following.

- a. Insulin and glucagon – Secreted from the endocrine region of pancreas
- b. Emulsification – Breaking of fat molecules into fatty acid and glycerol
- c. Trypsin – Protein digesting enzyme present in bile
- d. *Succus entericus* – Helps in the complete digestion of proteins, carbohydrates and fats

The incorrectly matched pairs are

- (1) b and c (2) c and d
- (3) a and c (4) a and b

9. Peptic ulcer results due to

- A. Imbalance of gastric juice secretion.
- B. Secretion of high acid enzyme.
- C. Poor secretion of mucus
- D. The disintegration of mucosal lining layer of stomach.

The correct ones are grouped in

- (1) B, C and D (2) A, B and D
- (3) A, B, C and D (4) A, B and D

10. The major parts of the digestive system of grass hopper are

- (1) Gizzard, crop and hepatic caecae
- (2) Foregut, midgut and hind gut
- (3) Gizzard, ileum and midgut
- (4) Pharynx, oesophagus and stomach

11. Select the wrong one(s) about respiration.

- It consists breathing, oxidation of food and energy storage in the form of ATP.
- Cytoplasm and mitochondria are necessary for the completion of aerobic respiration.
- Complete oxidation of food into ethanol or lactic acids, CO_2 and few molecules of ATP are seen in anaerobic respiration.
- In the older portions of woody plants, gaseous exchange takes place through stomatal apertures.

The totally wrong statements are given in

- a and b
- b and c
- a and d
- c and d

12. Gills are acting as the respiratory organ in

- Aquatic animals like fish, prawns and mussels.
- Aquatic annelids, cnidarians and echinoderms.
- Aquatic crustaceans, molluscs and sponges
- Amphibians, aquatic fishes, prawns and mussels.

13. Which of the following group of animals can breath by means of skin?

- Frogs, salamander and water snakes
- Earth worm, alligators and frog
- Frog, snail and leech
- Earth worm and frog

14. Grasshoppers, cockroaches and houseflies breath by means of

- Spiracles
- Trachea
- Cutaneous method
- Bucco-pharyngeal cavity

15. Consider the following statements A-D.

- Epiglottis is the cartilaginous flap of skin which regulates the flow of air into the trachea.
- Pleura is the ultimate region where in which the diffusion of air between the lungs and blood takes place.
- Larynx is the voice box, which is the enlarged part of trachea.
- "Adam's apple" is the protruding cartilage of the voice box of male humans.

The correct and wrong statements are given in

- A and B are correct; while C and D are wrong.
- B and C are correct; while A and D are wrong.
- C and D are correct; while A and B are wrong.
- A and D are correct; while B and C are wrong.

16. Lungs in the thoracic cavity is separated from the abdominal cavity by means of

- Peritonium
- Pleura
- Trachea
- Diaphragm

17. Exchange of gases takes place through the

- Wall of trachea and blood capillaries
- Wall of alveoli and blood capillaries
- Wall of pleura and diaphragm
- Wall of alveoli and bronchioles

18. Abhirami runs to her class room, as the school ball rang. What will be the probable rate of breathing in her lungs due to this vigorous act?

- 15 to 18 times per minute
- 16 to 20 times per minute
- 18 to 25 times per minute
- 20 to 25 times per minute

19. A person normally breathe how much volume of air in 24 hours?

- 15000 litres
- 1500 litres
- 500 litres
- 5000 litres

20. In which of the following group of animals, the spiracle, trachea and tracheoles are associated to the respiratory system?

- Frog and earthworm
- Prawns, molluscs and fishes
- Lizard, bird and fishes,
- Cockroaches, grass hoppers and houseflies.

21. Largest gland in the body is:

- Liver
- Pancreas
- Gastric gland
- Adrenals

22. The major site of absorption in alimentary canal is:

- Duodenum
- Stomach
- Ileum
- Jejunum

23. The hardest substance in human body:

- Dentine
- Collagen
- Melanin
- Enamel

24. Select the incorrect statement with regard to digestions.

- Saliva contains the enzyme ptyalin which is a protein digesting enzyme.
- The alternate contraction and relaxation of oesophagus is called peristalsis
- Salivary glands are exocrine glands secreting saliva.

- (4) Acidic digested pulpy food from the stomach is called chyme.
25. The proteins digesting enzyme in stomach which degrades milk proteins:
- (1) Pepsin (2) Trypsin
(3) Ptyalin (4) Rennin
26. Infoldings of stomach is known as
- (1) Rugae (2) Villi
(3) Gastric glands (4) Alveoli
27. Match the following and select the correct option:
- A. Vitamin A (i) Scurvy
B. Vitamin C (ii) Blood coagulation
C. Vitamin B (iii) Beri-beri
D. Vitamin E (iv) Night blindness
E. Vitamin K (v) Anti-fertility
- (1) A - (i), B - (ii), C - (iii), D - (iv), E - (v)
(2) A - (iv), B - (i), C - (iii), D - (v), E - (ii)
(3) A - (iv), B - (i), C - (ii), D - (v), E - (iii)
(4) A - (i), B - (iv), C - (iii), D - (ii), E - (v)
28. The opening of aorta is guarded by:
- (1) Tricuspid valve
(2) Mitral valve
(3) Semilunar valve
(4) Bicuspid valve
29. Functions as a middle man between blood and tissue fluid.
- (1) Plasma (2) Lymph
(3) Serum (4) Albumin
30. The instrument measuring blood pressure is
- (1) Stethoscope
(2) Electrocardiograph
(3) Electroencephalograph
(4) Sphygmomanometer
31. Oxygenated blood from lungs enters the heart through
- (1) Pulmonary vein
(2) Pulmonary artery
(3) Coronary vein
(4) Coronary artery
32. The largest leucocyte with kidney shaped nucleus is
- (1) Lymphocyte (2) Neutrophils
(3) Basophils (4) Monocytes
33. The excretory organs of prawn are
- (1) Malpighian tubules
(2) Nephridia
(3) Kidneys
(4) Green glands
34. The area of maximum reabsorption in a renal tubule occurs at
- (1) DCT (2) PCT
(3) Henle's loop (4) Glomerulus
35. The lymph vessel which aids in absorption and distribution of fats is
- (1) Lacteal (2) Villi
(3) Rugae (4) Vene cava
36. The collapse of trachea in the absence of air is prevented by
- (1) Bony rings
(2) Chitinous rings
(3) Cartilaginous rings
(4) Diaphragm
37. The largest artery is
- (1) Vene cava
(2) Pulmonary artery
(3) Aorta
(4) Pulmonary vein
38. The pacemaker of the heart is
- (1) AV node
(2) SA node
(3) Bundle of His
(4) Purkinje fibres
39. Select the incorrect statement(s).
- A. Arteries have thick elastic walls and veins have valves.
B. Capillaries are the smallest blood vessels supplying the tissues.
C. AV node is known as the pace setter of the heart.
D. Arteries carry blood towards the heart and veins carry blood away from the heart to different organs.
- (1) A and B (2) A and C
(3) C and D (4) D only
40. Major excretory nitrogenous product in humans is
- (1) Urea (2) Uric acid
(3) Ammonia (4) Creatinine

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the following pairs.

- | | |
|-----------------|--|
| A. Nutrition | – Intake and utilization of nutrients for energy requirement |
| B. Saprophytes | – Derives nutrition from dead organic matters. |
| C. Heterotrophs | – Animals and fungi |
| D. Chemotrophic | – N_2 fixing bacteria |

The correctly paired groups are given in

- | | |
|-------------------|----------------|
| (1) A, B and C | (2) B, C and D |
| (3) A, B, C and D | (4) A, C and D |

2. The correct equation of aerobic respiration is

- (1) Glucose \rightarrow Pyruvate \rightarrow $C_2H_5OH + CO_2 +$ Energy.
- (2) Glucose \rightarrow Pyruvate \rightarrow Lactic acid + $C_2H_5OH +$ Energy.
- (3) Glucose \rightarrow Pyruvate \rightarrow $CO_2 + C_2H_5OH +$ Energy + H_2O .
- (4) Glucose \rightarrow Pyruvate \rightarrow $CO_2 + H_2O +$ Energy.

3. Well developed digestive system is present in

- (1) Cnidarians, prawns and earthworms
- (2) Grasshoppers, frogs and houseflies.
- (3) *Amoeba*, *Hydra* and dog
- (4) Sponges, flatworms and earth words.

4. Which of the following is common features of *Amoeba*?

- (1) Pseudopodia, food vacuole, phagocytosis, assimilation and egestion.
- (2) Phagocytosis, contractile vacuole, lysosome, holozoic and ingestion
- (3) Contractile vacuole, absorption of food, egestion and grinding of food particles.
- (4) Pseudopodia, ciliary movement, contractile vacuole and phagocytosis.

5. Consider the following phagocytic events in *Amoeba*.

- A. Engulfed food particle.
- B. Extensions of plasma membrane as pseudopodia around the food particle.
- C. Food particle containing vacuole in the cytoplasm.
- D. Approaching to the food particle.

Which of the following is the correct sequence of phagocytosis?

- | | |
|-------------------|-------------------|
| (1) D – C – A – B | (2) C – A – B – D |
| (3) D – B – A – C | (4) D – A – B – C |

6. Which one of the following is wrong about the digestive system of grasshopper?

- (1) Wall of crop is muscular and its lumen is lined with cuticle.
- (2) A pair of small, branched salivary glands associated to anterior end of midgut.
- (3) Hepatic caecae are of six pairs of glands associated to the anterior end of midgut.
- (4) Malpighian tubules are the thread-like tubules with blunt tips associated to the junction of midgut and hindgut.

7. Digestive glands seen in human beings are

- (1) Gall bladder, liver and pancreas
- (2) Colon, salivary gland and liver
- (3) Liver, pancreas and vermiform appendix
- (4) Pancreas, salivary gland and liver

8. Ingestion of food in human beings is facilitated by

- | | |
|---------------------|-------------------|
| (1) Oesophagus | (2) Buccal cavity |
| (3) Muscular tongue | (4) Trachea |

9. Break down of proteins into peptones is carried by

- (1) Pepsin enzyme
- (2) Lipase enzyme
- (3) Amylase enzyme
- (4) Ptyalin

10. Duodenum, jejunum and ileum are the parts associated to

- | | |
|---------------------|---------------------|
| (1) Stomach | (2) Small intestine |
| (3) Large intestine | (4) Colon |

11. Consider the following pairs A–D.

- | | |
|---------------------|--|
| A. Pancreas | – Exocrine and endocrine |
| B. Liver | – Bile pigments and bile salts |
| C. Pancreatic juice | – Trypsin and amylase enzymes |
| D. Exocrine region | – Secretes digestive enzymes of pancreas |

The correct statements together are given in

- | | |
|----------------|-------------------|
| (1) A, C and D | (2) B, C and D |
| (3) A, B and D | (4) A, B, C and D |

12. Alkaline medium is essential for the functioning of pancreatic juice, which is provided by

- (1) The secretion of bicarbonate from the liver
- (2) The secretion of bicarbonate from the duodenal wall.
- (3) The secretion of bicarbonate from the pancreas.
- (4) The secretion of bile salts from the liver.

13. Statements A–D.

- A. Assimilation means the utilization of food for building up of replacement purposes and for deriving energy from it.
- B. Oesophagus wall is muscular and helps in mixing and grinding food particles.
- C. Duodenum receives the secretions of common bile duct from both liver and pancreas.
- D. Hydrochloric acid present in the gastric juice provides an acidic medium for the proper function of protein digesting enzyme pepsin.

The correct and wrong option is given in

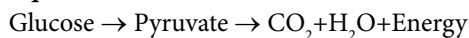
- (1) A and D are correct; while B and C are wrong
- (2) B and C are correct; while A and D are wrong
- (3) A and C are correct; while B and D are wrong
- (4) B and D are correct; while A and C are wrong

14. Which one is wrong statement?

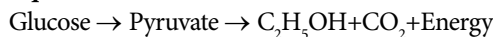
- (1) Glycolysis reactions never require molecular oxygen.
- (2) 3C-pyruvate is the end product of glycolysis.
- (3) Alcoholic fermentation in human muscle cells results its fatigue and cramping.
- (4) Lenticels seen in the older portion of root provide gas exchange in plants.

15. Consider the following two equation A and B.

Equation A



Equation B



Which one of the following is correct with respect to both the equations A and B?

- (1) A is aerobic respiration consisting of glycolysis and Krebs's cycle, B is anaerobic fermentation reaction.
- (2) A is anaerobic respiration and B is aerobic fermentation reactions.
- (3) A is aerobic respiration B is anaerobic lactic acid fermentation.
- (4) In both A and B reactions pyruvate under goes complete oxidation.

16. In heavy rainy monsoon season, certain low land plants which remain in flooded and water logged areas are subjected to wilting (death), the main reason for this is

- (1) Mineral nutrients absorption totally get blocked.
- (2) Water absorption do not take place.
- (3) Root tip meristems disintegrate.
- (4) Lenticels are not able to exchange gases between soil and living cells of roots.

17. Respiratory gas exchange in leaves takes place by means of

- (1) Osmosis
- (2) Imbibitions
- (3) Diffusion
- (4) Pressure flow

18. Which one of the following organisms is able to breathe by skin and lungs?

- (1) Earth worm
- (2) Frog
- (3) Grass hopper
- (4) Fishes

19. The entry of oxygen rich air in insects like grasshopper, cockroach and housefly takes place through

- (1) Mouth
- (2) Tracheoles
- (3) Trachea
- (4) Spiracles

20. Consider the following pairs about the organisms and their respective respiratory organ.

1. Earth worm – Moist skin of body
2. Mosquito – Tracheal system
3. Fish – Gills
4. Birds – Lungs

The correct ones are given in

- (1) 1, 2, 3 and 4
- (2) 1, 3 and 4
- (3) 2, 3 and 4
- (4) 3 and 4

21. The nasal openings of human beings are equivalent to

- (1) Cloaca of frog
- (2) Blood vessels in earth worm
- (3) Spiracles of insects
- (4) Osculum of sponges

22. Consider the statements A–D.

- A. Normal breathing rate of a person is 15 to 18 times per minute.
- B. Total area of gas exchange seen in the whole alveoli in two lungs is 36 to 72 square metre.
- C. The total volume of air breathed in an out in the cycle of inhalation and exhalation is 500 mL.
- D. Wind pipe is supported by rings of cartilage in order to avoid its collapse when there is lesser air in it.

The correct ones are given in

- (1) A, B and C (2) A, B, C and D
(3) A, B and D (4) B, C and D

23. Which of the following is/are wrong about blood clotting?

- A. Fibrinogen $\xrightarrow{\text{Thromboplastin}}$ Thrombin.
B. Injured tissues + blood platelets \rightarrow Release thromboplastin.
C. Prothrombin $\xrightarrow{\text{Thrombin}}$ Fibrin.
D. Fibrin+Red blood corpuscles \rightarrow Blood clot.

The wrong one(s) is/are given in

- (1) A and C (2) A only
(3) B and C (4) C only

24. If a seriously injured person is hospitalized in a critical condition, which blood group can be given immediately without testing the blood of the injured person?

- (1) AB blood group (2) B blood group
(3) O blood group (4) A blood group

25. Which one of the following is wrong?

- (1) White blood cells or leucocytes are considered as 'soldiers' of the body.
(2) Antibodies are produced by the stem cells of bone marrow.
(3) Calcium ions in blood play an important role in blood clot formation.
(4) Blood platelets are cell fragments, devoid of nuclei and participate in the coagulation of blood.

26. Consider the given groups A and B.

- | Group A | Group B |
|----------------------------------|---|
| 1. Bowman's capsule | A. bundle of blood capillaries seen in Bowman's capsule |
| 2. Glomerulus | B. Renal dialysis |
| 3. Reabsorption and conservation | C. Cup shaped upper end of nephron of water |
| 4. Artificial kidney | D. Marine and terrestrial animals |

The correctly paired one is

- (1) 1-A, 2-C, 3-D, 4-B
(2) 1-B, 2-A, 3-D, 4-C
(3) 1-A, 2-D, 3-B, 4-C
(4) 1-C, 2-A, 3-D, 4-B

27. If glucose and aminoacids enter the nephron along with filtrate, then

- (1) Glomerulus absorbs the glucose and aminoacids
(2) Renal artery absorbs the glucose and aminoacids.

- (3) Blood capillaries surrounding the nephron reabsorb the glucose and aminoacids.
(4) Blood capillaries surrounding the nephron reabsorb the filtrate.

28. The detoxification of substances in the body is carried out by

- (1) Liver (2) Lungs
(3) Kidney (4) Intestine

29. Choose the correct statement(s).

- (1) Fermentation is the process of conversion of pyruvate into ethanol and CO_2 under aerobic conditions.
(2) Pyruvate breakdown into CO_2 , water and energy occurs in the mitochondria during anaerobic respiration.
(3) Glycolysis is the breakdown of glucose into pyruvate by means of ten step reactions in the cytoplasm.
(4) The common respiratory substrate is glycogen.

30. The graveyard of RBC is

- (1) Liver (2) Gall bladder
(3) Bone marrow (4) Spleen

31. The left auricle opens into left ventricle through an aperture guarded by

- (1) Tricuspid valve (2) Bicuspid valve
(3) Mitral valves (4) Both (2) and (3)

32. The normal blood pressure of man in systolic/diastolic pressure is

- (1) 100/80 mm Hg (2) 100/120 mm Hg
(3) 80/120 mm Hg (4) 120/80 mm Hg

33. Which of the following statement(s) wrong with regard to heart?

- A. Left atrium receives oxygenated blood from different parts of the body while right atrium receives deoxygenated blood from the lungs.
B. Left ventricle pumps oxygenated blood to different body parts while right ventricle pumps deoxygenated blood to the lungs.
C. Right atrium receives deoxygenated blood from different body parts while left ventricle pumps oxygenated blood to different parts of the body.
D. Pulmonary vein carries deoxygenated blood to the lungs and pulmonary artery brings oxygenated blood towards the heart.

- (1) A and C (2) C only
(3) Both A and D (4) D only

- 34.** Life span of RBC is
 (1) 120 days (2) 80 days
 (3) 40 days (4) 1 week
- 35.** Chemical released by blood platelets is
 (1) Heparin (2) Thromboplastin
 (3) Fibrinogen (4) Prothrombin
- 36.** 70% of CO₂ transport in blood occurs in the form of
 (1) Bicarbonates
 (2) Carbaminohaemoglobin
 (3) Carboxyhaemoglobin
 (4) Carbonic acid
- 37.** The antimicrobial enzyme is
 (1) Lysozyme (2) Ptyalin
 (3) Steapsin (4) Protease
- 38.** The vitamin essential for the synthesis of prothrombin
 (1) Vitamin K (2) Vitamin E
 (3) Vitamin A (4) Vitamin D
- 39.** Which of the following statements are correct?
 A. Pyruvate can be converted into ethanol and carbon dioxide by yeast.
 B. Fermentation takes place in aerobic bacteria
 C. Fermentation takes place in mitochondria
 D. Fermentation is a kind of anaerobic respiration.
 (1) D only (2) Both B and C
 (3) Both A and D (4) Both C and D
- 40.** Haemodialysis is carried out in the case with a severe defect in
 (1) Kidney (2) Liver
 (3) Pancreas (4) Gall bladder

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 1 | 4. 4 | 5. 4 | 6. 3 | 7. 2 | 8. 1 | 9. 3 | 10. 2 |
| 11. 4 | 12. 1 | 13. 4 | 14. 2 | 15. 3 | 16. 4 | 17. 2 | 18. 4 | 19. 1 | 20. 4 |
| 21. 1 | 22. 3 | 23. 4 | 24. 1 | 25. 4 | 26. 1 | 27. 2 | 28. 3 | 29. 2 | 30. 4 |
| 31. 1 | 32. 4 | 33. 4 | 34. 2 | 35. 1 | 36. 3 | 37. 3 | 38. 2 | 39. 4 | 40. 1 |

PRACTICE EXERCISE 5 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 2 | 4. 1 | 5. 3 | 6. 1 | 7. 4 | 8. 3 | 9. 1 | 10. 2 |
| 11. 4 | 12. 2 | 13. 1 | 14. 3 | 15. 1 | 16. 4 | 17. 3 | 18. 2 | 19. 4 | 20. 1 |
| 21. 3 | 22. 2 | 23. 1 | 24. 3 | 25. 2 | 26. 4 | 27. 3 | 28. 1 | 29. 3 | 30. 4 |
| 31. 4 | 32. 4 | 33. 3 | 34. 1 | 35. 2 | 36. 1 | 37. 1 | 38. 1 | 39. 3 | 40. 1 |

Control and Co-ordination in Animals

SYNOPSIS

- The control and co-ordination in animals are carried by **chemicals** and **nervous system**.
- These two constitute **neuron-endocrine** system.
- The nervous system in humans are of **central** and **peripheral**.
- The peripheral nervous system (PNS) is further distinguished into **somatic nervous** system and **autonomic nervous** system.
- Neuro-endocrine system consists of network of **endocrine glands** where **hormone production** is controlled by central nervous system (CNS).

Neurons

- Nervous system comprises of nervous organs, nerves and neurons that control and co-ordinate body activities with the help of electrical impulses produced in responses to internal and external stimuli.
- **Neurons** or **nerve cells** are the **structural** and **functional units of nervous system**.
- Neurons are accompanied by companion cells called **glial cells** for **nourishment**.
- A nerve cell has three parts **Cell body** or **cyton**, **dendrites** and **axon**.
- The cell body contains **nucleus**, **Nissl granules**, **neurofibrils** and other cell organelles.
- **Dendrites** are the fine short and branched cytoplasmic process of the cell that bring information towards the cell body.
- Dendrites also contain Nissl granules.
- **Axon terminals** are often knob like and are called **synaptic knobs**.
- Synaptic knobs contains **neurotransmitters** which help in the **conduction of nerve impulses from one neuron to the next**.
- Axons are covered by sheaths. It is covered by a single layer of cells called **Schwann cells** which secretes an additional layer of fat called **myelin**.
- Myelinated nerve fibres bear **non-myelinated** areas called **nodes of Ranvier**.
- The junction between **two nerves** or between a **nerve and muscle** is known as a synapse where **transmission of nerve impulse occurs**.
- A neuron may be sensory, motor or connector.
- A **sensory neuron** is said to be **afferent** which **transmits the sensations** from different parts to the CNS whereas a **motor neuron** is **efferent** which **carries messages** to the muscle or gland to perform a function.
- Inter-neurons are connectors which passes the messages from sensory neuron to motor neurons.

Reflex Arc

- **Reflex** is associated with **sudden action in response to the environment**.
- The spontaneous involuntary response to a stimulus acting on a specific receptor without conscious effort or thought is called reflex action.
- The pathway taken by a stimulus to travel from receptor organs to effector organs is known as **reflex arc** and it is shown below.
Stimulus → Receptor organ like skin → Sensory neurons → CNS → Motor Neurons → Effector organ like muscle → Response.
- Knee jerk, coughing, sneezing, yawning, blinking of eyes, movement of diaphragm etc are the examples of reflex action.

Human Nervous System

- The human nervous system has two parts: **Central** and **Peripheral Nervous systems**.
- Central nervous system (CNS) comprises of **brain** and **spinal cord**.
- Peripheral nervous system (PNS) comprises of **all the nerves of the body** associated with brain and spinal cord as **cranial** and **spinal** nerves.
- Peripheral nervous system is of **somatic nervous system** (SNS) and **autonomous nervous system** (ANS).
- **Somatic nervous system** relays **impulses from the CNS to skeletal muscles** while the **autonomous nervous system** transmits impulses from the **CNS to the involuntary organs** and **smooth muscles** of the body.
- The ANS is of **sympathetic** and **parasympathetic** nervous system.

Human Brain

- The brain is the central information processing organ of our body and acts as the command and control system.
- The **brain controls** the **voluntary movements, balance of the body**, functioning of vital involuntary organs, **thermoregulation, hunger** and **thirst, rhythmic body functions**, activities of **endocrine glands** and **human behaviour**.
- Brain is also the site for processing of **vision, hearing, speech, memory, intelligence, emotions** and **thoughts**.
- Human brain is protected by the **cranium** and is covered by **cranial meninges**.

- The brain can be divided into three major parts: **Forebrain, Midbrain** and **Hindbrain**.
- Forebrain consists of **cerebrum, thalamus** and **hypothalamus**.
- **Cerebrum** forms the major part of the forebrain.
- A deep cleft divides the cerebrum longitudinally into two halves called **cerebral hemispheres** and are connected by **corpus callosum**.
- Each cerebral hemisphere is divided into four parts **frontal, parietal, temporal** and **occipital**.
- **Frontal lobes** are **centres of intelligence**.
- **Parietal lobes** have **centres of touch, smell temperature** and **conscious association**.
- **Temporal lobes** control auditory reception.
- **Occipital lobes** have centres of visual reception.
- Cerebrum wraps around a structure called **thalamus**, which is a major **co-ordinating centre for sensory and motor signaling**.
- **Hypothalamus** lies at the base of thalamus which contains a number of centres which control **body temperature, urge for eating and drinking**.
- It also contains several neuron secretory cells which secrete hypothalamic hormones which in turn controls the **pituitary gland**.
- **Midbrain** is located between the thalamus of the forebrain and pons of the hindbrain.
- The hindbrain comprises **pons, cerebellum** and **medulla oblongata**.
- **Cerebellum** is second largest parts of the brain which **co-ordinates** the adjustment of body movement and posture.
- **Medulla** of the brain is **connected to the spinal cord** and it **controls centres for respiration, heart beat regulation** and **blood pressure**.
- Pons regulates respiration in higher animals.

Sense Organs

- Various sensory receptors are present in our body associated with sense organs. These include
- Photoreceptors – detect light and form images in eyes.
- Gustatory receptors – detect taste on tongue
- Thermoreceptors – detect temperature on skin.
- Olfactory receptors – detect smell in nasal cavities
- Statoreceptors – detect changes in equilibrium in the inner ear.
- Phonoreceptors – detect sound in inner ear

- The organs which detect or pick up information from external and internal environment are called **sense organs**.
- They are five in number—**skin, nose, tongue, eyes and ears**.
- **Skin** in the **largest sense organ** with many **skin-receptors** for **pressure, pain, touch and temperature**.
- Sense of smell or odour is the ability to perceive chemical diffusing through air.
- The **olfactory epithelium** contains **mucus secreting Bowman's glands** and olfactory receptor cells.
- The tongue is associated with tasting of food taken in the mouth.
- There are **four basic tastes** like **sweet, salt, sour and bitter**.
- The organs of taste are **taste buds** which contain **gustatory receptors**.
- Organs of vision are a **pair of eyes** located in sockets of the skull called **orbits**.
- Eye ball is composed of three layers: a dense connective tissue **sclera** externally, middle vascular **choroid** layer and innermost – **retinal layer**.
- The anterior portion of sclera is called **cornea**.
- The visible coloured portion of the eye is called **iris** which covers a transparent crystalline **lens**.
- The light falls on the lens through an aperture on iris called **pupil**.
- The diameter of pupil is regulated by the muscle fibres of iris.
- The inner layer retina contains three layers of cells **ganglion cells, bipolar nerve cells and photoreceptor cells**.
- There are two types of photoreceptor cells namely **rods and cones**.
- **Rods and cones** contain **light sensitive photo pigments**.
- **Cones** help in **daylight (photopic) vision** and **coloured vision** whereas **rods** function in **twilight or scotopic vision**.
- Rods contain pigmented protein called **rhodopsin** or **visual purple** which is a **derivative of vitamin A**.
- Ears perform two sensory functions: **hearing and equilibrium**.
- Anatomically, ear can be divided into three major sections: **outer ear, middle ear** and the **inner ear**.
- The outer ear consists of the **pinna** and **external auditory meatus** which leads inwards in to the **tympanic membrane** or **ear drum**.

- Middle ear comprises a chain of small **ear ossicles** like **malleus, incus and stapes**.
- **Eustachian tube** connects middle ear with pharynx and **helps in pressure maintenance**.
- Inner ear is formed of three parts: **Vestibule, semi-circular ducts** and **Cochlea**.
- The vestibule and semicircular canals contain **macula and crista** respectively **for equilibrium**.
- **Cochlea** is the highly coiled portion of the inner ear and is formed by a partition due to two membranes: **Reissner's membrane** and **Basilar membrane**.
- The organ of hearing – **Organ of Corti** is present on the **basilar membrane**.
- In *Hydra* (Cnidarian), **nerve cells** form a **nerve-net** in the body for co-ordination.
- In **earthworms**, the nerve nets condense to form **nerve mass (ganglion)** for co-ordination.
- Higher invertebrates like insects have **bilobed nerve mass (brain), nerve cord** and **nerve ganglia**.

Endocrine System

- Endocrine system in animals comprises of a group of **ductless glands** and its secretions are called **hormones**.
- Hormones are non-nutrient chemical messengers which are produced in minute quantities and have specific site of action – target organ.
- The major components of human endocrine system are **hypothalamus, pituitary gland, pineal gland, thyroid, parathyroids, thymus, adrenals, pancreas and gonads**.
- **Hypothalamus** is a part of the forebrain and produces neurohormones which are passed on to pituitary gland for controlling its activity.
- Pituitary gland is a small pea-shaped gland which is located on to the inferior surface of hypothalamus by a stalk called **infundibulum**.
- **Pituitary gland** is known as **master endocrine gland** because its secretions control the functioning of other endocrine glands.
- Pituitary has three parts, anterior, middle and posterior.
- Anterior pituitary produces **growth hormones** (somatic cells), **prolactin** (mammary glands), **Thyroid stimulating hormone** (thyroid), **Adrenocorticotrophic hormone** (adrenal gland), **Follicle stimulating hormone** (testis and ovaries) and **Leutinizing Hormone** (gonads).

- **Middle lobe** of pituitary secretes **Melanocyte stimulating hormone** which controls **skin pigmentation**.
- **Posterior pituitary** produces two hormones: **Oxytocin** and **vasopressin**
- **Oxytocin** stimulates **uterus contractions** during child birth and **milk ejection**. So, it is called **birth hormone**.
- **Vasopressin** or **Anti diuretic hormone** (ADH) is essential for **water reabsorption from the renal tubules** for **producing concentrated urine** to prevent **diuresis**.
- **Pineal gland** secretes hormone **melatonin** controlling **sleep–wake cycle, mood and sexual cycles**.
- **Thyroid** is the **largest gland** which produces **iodine containing hormone** called **thyroxine**.
- The deficiency of thyroxine in children leads to physical and mental underdevelopment called **cretinism**.
- In adults, **myxedema** results due to low production of thyroxine.
- Over secretion of thyroxine leads to **Grave's disease** or **Exophthalmia**.
- **Thyroid also secretes a non-iodinated hormone** called **calcitonin** which checks the **blood calcium levels**.
- **Parathyroids** secrete **Parathormone** which maintains optimum calcium as well as phosphate in the blood.
- **Thymus** is known as the **throne of immunity** because it is the **site of maturation of T-lymphocytes**. The hormones produced are collectively known as **thymosin**.
- **Adrenal glands** are associated with kidney and has an outer **cortex** and inner medulla.
- **Adrenal cortex** secretes **corticoids** which includes **glucocorticoids, mineralocorticoids and sex corticoids**.
- **Adrenal medulla** produces two hormones: **adrenaline** and **non-adrenaline** which are called **emergency hormones** or **3F (Fight, Fright and Flight) hormones**.
- **Pancreas** is a **heterocrine gland** with **exocrine and endocrine functions**.
- Specialized cells called **Islets of langerhans** produce two hormones: **insulin** and **glucagon**.
- **Insulin** produced by **β-cells** of Islets of langerhans is a **hypoglycemic hormone** which **decreases the blood glucose level** where as **glucagon** secreted by **α-cells** is a **hyperglycemic hormone** which **increases the level of glucose in the blood**.
- **Gonads** are **testis** in males and **ovaries** in females.
- The **Leydig cells** or **interstitial cells of testis** produce the **male sex hormone testosterone**.
- Ovaries produce the ovum or egg and also secrete the **female sex hormone called estrogen**.
- The **mature ovarian follicle ruptures** to **release the ovum** and forms **corpus luteum**.
- The corpus luteum secretes **progesterone** which **maintains pregnancy**.
- In addition to these glands, kidney, heart, gastrointestinal tract also function as endocrine glands.

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The part of neuron which brings information towards the cell body is

(1) Dendrites	(2) Axon
(3) Synaptic knob	(4) Myelin
2. Receptors which sense taste present on tongue are

(1) Olfactory receptors	(2) Phonoreceptors
(3) Statoreceptors	(4) Gustatory receptors
3. Neurotransmitters are present in

(1) Schwann cells	(2) Synaptic knobs
(3) Dendrites	(4) Myelin
4. The unmyelinated areas on myelinated nerve fibres are

(1) Nodes of Ranvier	(2) Synaptic knobs
(3) Schwann cells	(4) Dendrite
5. Structure and functional unit of nervous system is

(1) Nephron	(2) Cyton
(3) Neuron	(4) Axon
6. The number of pairs of spinal nerves in man is

(1) 10	(2) 12
(3) 34	(4) 31
7. The part of nervous system which controls the heart beat rate is called

(1) Central NS	(2) PNS
(3) ANS	(4) Somatic NS

8. The involuntary actions in the body are controlled by
 - (1) Spinal cord (2) Cerebellum
 - (3) Medulla in forebrain (4) Medulla in hindbrain
9. The centre of intelligence in the forebrain is
 - (1) Frontal (2) Parietal
 - (3) Temporal (4) Occipital
10. The part of brain controlling body temperature, urge for eating and drinking is
 - (1) Pituitary (2) Cerebrum
 - (3) Hypothalamus (4) Cerebellum
11. The visible coloured portion of the eye is
 - (1) Cornea (2) Pupil
 - (3) Lens (4) Iris
12. Select the correct statement(s) with regard to brain.
 - A. Thalamus is the major coordinating centre for sensory and motor signaling.
 - B. Cerebral hemispheres are connected by corpus callosum.
 - C. Corpora quadrigemina are present in the mid-brain.
 - D. The pneumotaxic centre controlling the respiration rate is located in the cerebellum.
 - (1) A and B only (2) A, B and C
 - (3) A, B and D (4) D only
13. The hormone synthesis requiring iodine is
 - (1) Thymosin (2) Parathormone
 - (3) Thyroxine (4) Corticoids
14. The vascular layer of the eye is
 - (1) Choroid (2) Sclera
 - (3) Cornea (4) Retina
15. The endocrine gland associated with brain is
 - (1) Adrenal (2) Parathyroid
 - (3) Thymus (4) Pituitary
16. Which gland secretes digestive enzymes as well as hormones?
 - (1) Adrenals (2) Pancreas
 - (3) Thyroid (4) Thymus
17. Identify the mismatched pair from the following.
 - (1) Emergency hormone – Adrenal gland
 - (2) Birth hormone – Pituitary gland
 - (3) Pregnancy hormone – Ovarian follicles
 - (4) Gonadotropins – Gonads
18. The hormone involved in the active water reabsorption in renal tubules.
 - (1) Anti-diuretic hormone
 - (2) Vasopressin
 - (3) Adrenaline
 - (4) Both 1 and 2
19. Deficiency of iodine results in
 - (1) Goitre (2) Exophthalmia
 - (3) Grave's disease (4) Cretinism
20. The cells secreting testosterone are
 - (1) Islets of langerhans (2) Nuclei
 - (3) Leydig cells (4) Sertoli cells
21. The common neurotransmitter of peripheral nervous system
 - (1) Epinephrine (2) Acetylcholine
 - (3) Norepinephrine (4) GABA
22. Cerebral cortex consists of
 - (1) Grey matter (2) Duramater
 - (3) White matter (4) Arachinoid mater
23. Ventricles of the brain are filled with a fluid called
 - (1) Lymph (2) Plasma
 - (3) Perilymph (4) Cerebrospinal fluid
24. Eustachian tube connects
 - (1) External ear and middle ear.
 - (2) External ear and pharynx.
 - (3) Middle ear and pharynx
 - (4) Middle ear and inner ear
25. Light rays entering the eye is controlled by
 - (1) Pupil (2) Iris
 - (3) Cornea (4) Enzymes
26. Smallest ear ossicle is
 - (1) Malleus (2) Incus
 - (3) Stapes (4) Cochlea
27. Lacrimal glands are concerned with the secretion of
 - (1) Hormones (2) Tears
 - (3) Digestive juice (4) Enzymes
28. The membranous labyrinth seen in the ear is concerned with
 - (1) Hearing
 - (2) Equilibrium
 - (3) Both 1 and 2
 - (4) Sound production

29. The gland which is related to the production of lymphocytes and antibodies.
 (1) Thymus (2) Thyroid
 (3) Adrenal (4) Pituitary
30. The thermoregulatory centre in higher animals is found in
 (1) Pituitary (2) Medulla
 (3) Thalamus (4) Hypothalamus
31. Outer covering of brain is called as
 (1) Pleura (2) Meninges
 (3) Peritoneum (4) Perimetrium
32. A junction between the axon of a neuron and dendrites of next one is
 (1) Synaptic cleft (2) Cell junction
 (3) Synapse (4) Channel
33. The fluid present in the membranous labyrinth of ear is
 (1) Plasma (2) Endolymph
 (3) Perilymph (4) Blood
34. Match the contents in group A and B and select the correct option.
- | Group A | Group B |
|--------------------------|------------------|
| A. Hypoglycemic hormone | (i) Adrenaline |
| B. Emergency hormone | (ii) Glucagon |
| C. Hyperglycemic hormone | (iii) Insulin |
| D. Releasing hormone | (iv) Calcitonin |
| E. Hypercalcemic hormone | (v) Hypothalamus |
- (1) A-(iii), B-(i), C-(ii), D-(v), E-(iv)
 (2) A-(ii), B-(iv), C-(iii), D-(i), E-(v)
 (3) A-(ii), B-(iv), C-(i), D-(v), E-(iii)
 (4) A-(iii), B-(i), C-(v), D-(iv), E-(ii)
35. Select the wrong statements with regard to hormonal disorders.
 (1) The deficiency of thyroxine in children leads to physical and mental retardation and result cretinism.
 (2) Hyposecretion of aldosterone and cortisol results Addison's disease.
 (3) Elevated level of cortisol in the blood results in Cushing's syndrome
 (4) Grave's disease is an autoimmune disorder results due to hypothyroidism.
36. The smallest endocrine gland is
 (1) Thyroid (2) Pituitary
 (3) Pineal (4) Thymus
37. Which endocrine gland becomes inactive after puberty?
 (1) Thyroid (2) Parathyroid
 (3) Thymus (4) Gonads
38. Gonadotropic hormones are
 (1) Testosterone and aldosterone
 (2) LH and FSH
 (3) Estrogen and progesterone
 (4) Prolactin and Oxytocin
39. The size of pupil is controlled by the
 (1) Ciliary muscles (2) Ligaments
 (3) Cornea (4) Iris muscles
40. The electrical potential difference across the plasma membrane of a neuron during conduction of nerve impulse is known as
 (1) Excitation potential (2) Impulse potential
 (3) Resting potential (4) Action potential

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Statoreceptors are meant for sensing
 (1) Taste (2) Heat
 (3) Balance (4) Sound waves
2. The part of the neuron through which information travels as an impulse is
 (1) Dendrite (2) Axon
 (3) Cell body (4) Nerve ending
3. The sequence of a reflex arc is
 (1) Receptor → Sensory neuron → Motor neuron → Effector → Response
 (2) Effector → Sensory neuron → Motor neuron → Receptor → Response

- (3) Effector → Motor neuron → Interneuron → Receptor → Response
 (4) Receptor → Motor neuron → Sensory neuron → Effector → Response
4. The respiratory centre of the brain is located in
 (1) Medulla oblongata (2) Pons
 (3) Cerebellum (4) Cerebrum
5. Spinal cord is the part of
 (1) Autonomous nervous system
 (2) Peripheral nervous system
 (3) Somatic nervous system
 (4) Central nervous system
6. The largest and well developed part of the brain is
 (1) Cerebellum (2) Cerebrum
 (3) Mid brain (4) Medulla
7. The part of brain which is known as 'master of master gland'.
 (1) Hypothalamus (2) Pituitary gland
 (3) Cerebrum (4) Cerebellum
8. Which part of the brain control the posture and balance of the body?
 (1) Cerebrum (2) Medulla
 (3) Cerebellum (4) Pons varoli
9. The cells which help in colour vision is
 (1) Cones (2) Ganglion cells
 (3) Bipolar cells (4) Pods
10. Find out the incorrect statement.
 (1) The organ of corti is present on the basilar membrane in the cochlea.
 (2) Rods contain pigmented protein called rhodopsin which helps in dim light vision.
 (3) The tongue contains gustatory receptors for sweet, salt, sour and bitter.
 (4) Macula and cristae are present in the inner ear which function in hearing.
11. The hormone known as 'birth hormone' is
 (1) Prolactin
 (2) Oxytocin
 (3) Progesterone
 (4) Relaxin
12. Somatotropins are secreted by
 (1) Hypothalamus (2) Pineal
 (3) Thymus (4) Pituitary
13. The hormones with antagonistic action are
 (1) Adrenaline and Non-adrenaline
 (2) Glycocorticoid and Mineralocorticoid
 (3) Insulin and Glucagon
 (4) Thymosin and Parathormone
14. The hormone responsible for changes in female at puberty is
 (1) Estrogen (2) Progesterone
 (3) Testosterone (4) Oxytocin
15. Dwarfism results due to deficiency of the hormone
 (1) Somatostatin (2) Thyroxine
 (3) Somatotropin (4) Mineralocortodoid
16. The follicle stimulating hormone (FSH) is secreted by
 (1) Thyroid (2) Anterior pituitary
 (3) Posterior pituitary (4) Hypothalamus
17. Ovulation in female is controlled by
 (1) Estrogen
 (2) Progesterone
 (3) Follicle Stimulating Hormone
 (4) Lutenising Hormone
18. The hormone produced by intermediate lobe of pituitary is
 (1) Oxytocin
 (2) Vasopressin
 (3) Melanocyte stimulating hormone (MSH)
 (4) Follicle stimulating hormone (FSH)
19. Dwarfism results due to
 (1) Excess secretion of thyroxine
 (2) Lower secretion of growth hormone
 (3) Higher secretion of growth hormone
 (4) Hypo secretion of adrenaline
20. The type of vision which helps organisms to be visualized at dim light is
 (1) Scotopic vision (2) Photopic vision
 (3) Mosaic vision (4) Binocular vision
21. Select the wrong paired match from the following.
 (1) CNS – Site of information processing and control
 (2) PNS – Transmission of impulses to and from the CNS
 (3) SNS – Relays impulses from the CNS to skeletal muscles
 (4) ANS – Transmission of impulses from the CNS to voluntary organs

22. The main mineralocorticoid seen in human is
(1) Adrenaline (2) Testosterone
(3) Androsterone (4) Aldosterone
23. The hormone which regulates basal metabolic rate (BMR) of the body.
(1) Thyroid hormone (2) Thymosin
(3) Corticoid (4) Pituitary hormone
24. Select the incorrect pairs from the following.
A. Melanocyte stimulating hormone regulates skin pigmentation.
B. Diurnal rhythm of our body is regulated by the hormone melatonin.
C. The main glucocorticoid present in our body is cortisol.
D. Calcitonin is secreted by parathyroid gland.
E. Iodine is essential for the synthesis and secretion of parathyroid hormones.
(1) A, C and D (2) A, B and D
(3) D and E (4) B and D
25. Choose the peptide hormone from the following.
(1) Adrenaline (2) Insulin
(3) Testosterone (4) Thyroxine
26. The hormone known as pregnancy hormone is
(1) Prolactin (2) Oxytocin
(3) Estrogen (4) Progesterone
27. The brain is responsible for
(1) Thinking
(2) Regulation of heart beat
(3) Thermo regulation
(4) All 1, 2 and 3
28. Salivation at the sight of smell of food is
(1) Peristalsis
(2) Reflex action
(3) Sympathetic action
(4) Parasympathetic action
29. Diabetes insipidus is due to the deficiency of hormone
(1) ADH (Anti Diuretic Hormone)
(2) Insulin
(3) Glucagon
(4) Cortisol
30. Which of the following statements about nerve impulse transmission is incorrect?
(1) Nerve impulse travels from dendrites end to axonal end.
(2) The chemical released from axonal end of one neuron crosses the synapse and generates impulse in dendrite of other neuron.
(3) At dendrite end, electrical impulses bring about the release of neurotransmitters which generate an electric impulse at the axonal end of another neuron.
(4) A neuron transmits electrical impulses not only to another neuron but also to muscle and gland cells.
31. Spinal cord originates from
(1) Cerebrum (2) Medulla
(3) Pons (4) Cerebellum
32. The activity of brain is generally recorded by
(1) ECG (2) MRI scan
(3) CT scan (4) EEG
33. The source of progesterone is
(1) Corpus luteum (2) Ovary
(3) Ovarian follicle (4) Uterus
34. Select the wrongly paired match.
(1) Parietal lobe – Touch, smell, temperature and conscious association
(2) Occipital lobe – Visual reception
(3) Frontal lobe – Sexual behaviour and emotions
(4) Temporal lobe – Auditory reception
35. Hormone responsible for the development of moustache and beard in man is
(1) Sex corticoid (2) Testosterone
(3) Thyroxine (4) Thymosin
36. The impulse of sound is conducted to the brain by
(1) Olfactory nerve
(2) Auditory nerve
(3) Optic nerve
(4) Trachea nerve
37. The waxy substance which coats the surface of auditory canal is
(1) Mucus (2) Plasma
(3) Endolymph (4) Cerumen
38. Tectorial membrane is found in
(1) Brain (2) Eye
(3) Ear (4) Digestive tract

39. Short sightedness is otherwise known as

- (1) Myopia
- (2) Hypermyopia
- (3) Astigmatism
- (4) Presbyopia

40. An animal having more rods will be

- (1) Active during day
- (2) Active during night
- (3) Have colour vision
- (4) Equally active during day and night

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

1. 1	2. 4	3. 2	4. 1	5. 3	6. 4	7. 3	8. 4	9. 1	10. 3
11. 4	12. 2	13. 3	14. 1	15. 4	16. 2	17. 4	18. 4	19. 1	20. 3
21. 2	22. 1	23. 4	24. 3	25. 1	26. 3	27. 2	28. 3	29. 1	30. 4
31. 2	32. 3	33. 2	34. 1	35. 4	36. 2	37. 3	38. 2	39. 1	40. 4

PRACTICE EXERCISE 6 (B)

1. 3	2. 2	3. 1	4. 1	5. 4	6. 2	7. 1	8. 3	9. 1	10. 4
11. 2	12. 4	13. 3	14. 1	15. 3	16. 2	17. 4	18. 3	19. 2	20. 1
21. 4	22. 4	23. 1	24. 3	25. 2	26. 4	27. 4	28. 2	29. 1	30. 3
31. 2	32. 4	33. 1	34. 3	35. 2	36. 2	37. 4	38. 3	39. 1	40. 2

Reproduction in Animals

SYNOPSIS

- Reproduction is a biological process in which organisms produce young ones similar to themselves in most characters.
- The basic function of reproduction is the maintenance of continuity of species.
- The basic events in reproduction are DNA replication and cell division.
- Small **variations** occur in DNA **due to mutation** during DNA replication which **forms the basis of evolution**.
- Variations are useful for the survival of species over time.
- Reproduction is of two types: asexual and sexual.
- Asexual reproduction is performed by single parent while sexual reproduction generally requires two parents of different sexes.
- Vegetative propagation is a type of asexual reproduction seen in plants and lower most organisms.
- All the individuals formed through asexual reproduction are **genetically** and **morphologically identical** and are called **clones**.
- The most common method of asexual reproduction is **fission**. It occurs in unicellular organisms.
- **Binary fission** means 'splitting into two'. It involves the nuclear division into two, followed by the cleavage of cytoplasm to form two daughter individuals.
- In *Amoeba*, binary fission can occur in any plane whereas in *Paramecium*, the plane is longitudinal.
- In *Leishmania* and *Euglena*, the plane of division is transverse.
- **Multiple fission** occurs in **malarial parasite** *Plasmodium* where the cell divides and splits internally to form a number of daughter individuals.
- Multiple fission can also occur in yeasts.
- **Fragmentation** is the process of breaking up of the body of an organism into two or more fragments (bits) each of which grows into a new individual.
- Fragmentation is common in algae and fungi.
- **Regeneration** is the property of a fully differentiated organism to give rise to new individual organisms from their body part.
- Simple animals like *Hydra* and *Planaria* can be cut into any number of pieces and each piece grows into a complete organism.

Asexual Reproduction

- It is a process of formation of new individuals from a **single parent without fertilization** or fusion of gametes. So, it is called **uniparental**.

- Higher animals have limited power of regeneration E.g., Tail in wall lizard, arms in star fish etc.
- Regeneration is carried out by specialized cells. These cells proliferate and make large number of cells. From this mass of cells, different cells undergo changes to become various cell types and tissues.
- **Budding** is a mode of reproduction in which one or more outgrowths develop from the body of an organism which then separate to form new individuals.
- *Hydra* multiplies by **budding** under favourable conditions. The buds develop into tiny individuals and when fully mature with mouth and tentacles formed terminally, detach from the parent body and become new independent individuals.
- Unicellular organisms **yeast** also reproduce by **budding**.
- **Sponges** also produce **internal buds** called **gemmules** which are produced in unfavourable conditions and give rise to a colony.
- **Spore formation** commonly occurs in **bacteria, algae and fungi**. Spores are very minute unicellular asexual reproductive bodies which get dispersed and form new individual on germination.
- In fungi like *Rhizopus*, the spores are formed on specialized hyphae known as **sporangium**.
- In algae and fungi, the motile spores are called **zoospores**.
- In bacteria, thick walled resistant structures are formed called **endospores** which can by-pass the unfavourable conditions.

Sexual Reproduction

- It is a mode of multiplication in which the young ones are produced through the process of **formation and fusion of gametes**.
- It is usually **biparental** which involves two individuals, **male and female**.
- The **gametes** are always **haploid** and **meiosis** takes place in the individuals at the time of gamete formation.
- The gametes undergo fusion to form a **diploid** cell called **zygote**. Fertilization restores the diploid number of chromosome in the life cycle.

Reproduction in Human Beings

- Human beings are sexually reproducing, **sexual dimorphic** organisms and are **viviparous**.

- The reproductive events in humans include the formation of gametes (**gametogenesis**), **insemination, fertilization, implantation, gestation and parturition**.
- The period when **reproductive maturity** begins to appear is called **puberty**.
- Sex organs which produce germ cells or gametes are called **primary sex organs**, **testis** in males and **ovaries** in females.
- The sex organs which conduct and nourish the gametes are known as **secondary sex organs**.
- Characters which distinguish a male from a female at the time of birth are called primary sex characters.
- The characters which develop later on during puberty are known as **secondary sexual characters**. E.g., breasts in females beard in males.
- The **male reproductive system** includes a pair of **testes, accessory ducts, glands** and the **external genitalia**.
- The formation of germ cells takes place in the **testis**.
- Testes are the male gonads or primary sex organs which produce sperms and secrete male sex hormone called **testosterone**.
- **Testes** are **situated outside the abdominal cavity** within a pouch called **scrotum**.
- The scrotum helps in maintaining a **temperature lower** than the body temperature **necessary for spermatogenesis**.
- Each testis has about 250 compartments called **testicular lobules** each containing one to three **seminiferous tubules**.
- Each seminiferous tubule is lined by **male germ cells** and **Sertoli cells**.
- The male germ cells undergo meiotic division to form sperms.
- **Sertoli cells provide nutrition** to the germ cells.
- The regions outside the seminiferous tubules contain interstitial space containing **interstitial cells** or **leydig cells** which **synthesize and secrete testicular hormones** called **androgens (testosterone)**.
- The sperms are delivered from seminiferous tubules into **vas deferens** which unites with a tube coming from urinary bladder.
- **Urethra** forms a **common passage for both the sperms and urine** and forms the **urinogenital tract**.
- **Accessory glands** include **prostate and seminal vesicles** that add their **secretions** which are **essential for the nourishment and motility of the sperms**.

- Penis forms the male erectile copulatory organs which comprises the external male genitalia.
- **Sperms** are the **male gametes** which are tiny bodies that contains the genetic material and long tail which helps in motility.
- The process of production of sperms from immature germ cells is called **spermatogenesis** and it begins at puberty.
- The **female reproductive system** consists of a pair of **ovaries** along with a pair of **oviducts, uterus, cervix, vagina** and **external genitalia**.
- **Mammary glands** are also present and together they support the processes of ovulation, fertilization, pregnancy, birth and child care.
- Ovaries are the **female gonads** or primary sex organs which are responsible for the production of **ovum** (egg) and the **female sex hormones**.
- Each ovary contains **thousands of immature eggs** or **follicles** at the **time of birth** and on **reaching puberty**, they **start maturing**.
- Maturation of eggs occur in **ovarian follicles** inside the ovary and on maturation, a **single ovum** or **egg** is released.
- The mature follicle is called **Graafian follicle**.
- The **ovarian follicles secrete** the hormone **estrogen** and **progesterone** is **secreted by corpus luteum** formed from the degenerating Graafian follicle.
- Oviducts or **fallopian tube carries the egg** from the ovary towards the uterus or womb.
- Uterus is a thick walled muscular bag like organ to retain and nourish the foetus during pregnancy.
- Uterus opens into the vagina through the cervix. The **cervix along with vagina** forms the **birth canal**.
- The process of formation of a mature female gamete is called **oogenesis**.
- **Insemination** is the process by the sperms enter into the female reproductive tract during sexual intercourse.
- The sperms being motile, travel upwards and reach the oviduct where they encounter the egg and results fertilization to form the zygote.
- The zygote undergoes a series of **mitotic divisions** called **cleavage** and migrates towards the uterus for **implantation**.
- The inner walls of the uterus thickens and is richly supplied with blood to nourish the growing embryo.
- The **embryo gets nutrition** from the **mother's blood** with the help of a special tissue called **placenta**.
- Placenta provides a large surface area for exchange of materials between embryo and mother.
- An **umbilical cord** attaches the growing foetus with the placenta.
- Total period of embryonic development is called **gestation**.
- Gestation period in human is **270 days**.
- The process of **giving birth to young one** is known as **parturition**.
- The child is born as a result of rhythmic contractions of the muscles in the uterus in the presence of **oxytocin** hormone.
- If the egg is not fertilized, it lives for one day and is then expelled. This initiates a series of cyclic changes in the reproductive system of human female called **menstrual cycle** or **ovarian cycle**.
- The first menstruation is called **menarche**.
- Menstruation stops at an age of 40-50 years.
- Permanent stoppage of menstruation is **menopause**.
- **Menstrual cycle** occurs at regular intervals of about **28 days**. It consists of four phases like proliferative ovulation, secretory and menstrual.
- **Proliferative phase** involves the thickening of the **inner walls of uterus (endometrium)** in order to conceive the embryo. Under the influence of FSH, the follicles undergo maturation in the ovaries and secretes the hormone estrogen.
- **Ovulation** involves the release of ovum in presence of hormone LH. The empty follicle grows into corpus luteum that secretes hormone progesterone. This period is called fertility period.
- **Secretory phase** involves further thickening of the uterine wall and begins to secrete materials for nourishment of the egg, if it happens to get fertilized. In the absence of fertilization, the menstrual phase begins to degeneration of corpus luteum and non-secretion of progesterone.
- **Menstrual phase** involves the **breakdown of uterine wall** and as a result **blood, mucus, fragments of tissues** etc., are discharged through the vagina. The process is called **menses**.
- In sexual reproduction, the offsprings are produced through fertilization.
- In some organisms, **egg develops without fertilization** and young ones are born. This phenomenon is called **parthenogenesis**. E.g., Honey bee.

Population Control

- Population growth can be controlled by **barrier**, chemical and **surgical** methods.
- **Condoms, diaphragms** and cervical caps are the common barriers.
- **Barriers prevent the entry of sperms** in the female genital tract during copulation.
- **Oral pills** and **vaginal pills** are the **chemical methods** used by the females.
- **Oral pills** are the **hormonal preparations** and are commonly known as the **oral contraceptives (OCs)**.
- **Copper-T** is the common **Intrauterine contraceptive Devices (IUCDs)** used for **preventing implantation** in the uterus.
- **Vasectomy** and **tubectomy** are the surgical methods practiced for birth control.
- A portion of **vas deferens** is removed from the **males** is known as **vasectomy**.
- **Removal of a portion of fallopian tube** in **female** is known as **tubectomy**.

Reproductive Health and Sexually Transmitted Diseases (STDs)

- Safe and satisfying reproductive life is reproductive health.
- Fertility regulation methods, the right the freedom and the choice to control child birth, ability to prevent and control sexually transmitted disease and manage the disorders related to the reproductive systems are the aspects of reproductive health.
- Diseases that are transmitted through sexual contacts are known as sexually transmitted diseases (STDs).
- **Gonorrhea, syphilis** and **trichomoniasis** are the common STDs.
- AIDS (Acquired Immuno Deficiency Syndrome) is another fatal STD.
- AIDS is caused by **Human Immunodeficiency Virus (HIV)**.
- Various organization like World Health Organization (WHO), National Population Policy, National Health Policy of India, Family Planning Programme and Non-Government Organization (NGO) are involved into reproductive health programmes.

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Budding is the common method of asexual reproduction seen in:
 - (1) *Planaria* and Yeast (2) *Hydra* and Yeast
 - (3) *Rhizopus* and Yeast (4) *Amoeba* and *Hydra*
2. The method of reproduction in Honey bee is
 - (1) Sexual (2) Asexual
 - (3) Parthenogenesis (4) Both 1 and 3
3. Thick walled resistant structures formed in bacteria during unfavourable conditions are
 - (1) Gemmules (2) Zoospores
 - (3) Endospores (4) Conidia
4. Binary fission in *Amoeba* is a mode of
 - (1) Vegetative multiplication
 - (2) Asexual Reproduction
 - (3) Sexual Reproduction
 - (4) Parthenogenesis
5. In which mode of reproduction, the identity of parent is lost?
 - (1) Budding
 - (2) Binary Fission
 - (3) Multiple fission
 - (4) Both 2 and 3
6. The morphologically and genetically identical organisms formed as a result of asexual reproduction is called as:
 - (1) Clones (2) Hybrids
 - (3) Cybrids (4) Twins
7. The method of reproduction without fertilization is
 - (1) Sexual
 - (2) Parthenogenesis
 - (3) Apomixis
 - (4) Amphimixis
8. Select the incorrect statement.
 - (1) Gametes are always haploid and are formed as a result of meiosis.
 - (2) The period when an organisms acquires reproductive maturity is called puberty.
 - (3) The process of formation of gametes is known as gametogenesis.
 - (4) The period of embryonic development is called implantation.
9. The structure which helps to maintain optimum temperature for spermatogenesis is
 - (1) Testes (2) Scrotum
 - (3) Prostate (4) Penis
10. The cells which provide nourishment for the germ cells.
 - (1) Leydig cells (2) Interstitial cells
 - (3) Sertoli cells (4) Spermatocytes
11. The oviduct in human female is called
 - (1) Fallopian tube (2) Cervix
 - (3) Vagina (4) Womb
12. The process of formation of sperms is called
 - (1) Spermiation (2) Spermiogenesis
 - (3) Spermatogenesis (4) Oogenesis
13. Motility of sperm is aided by its
 - (1) Head (2) Tail
 - (3) Acrosome (4) Neck
14. The secretion of the seminal vesicles, prostate and bulbourethral glands along with sperms is called
 - (1) Seminal fluid (2) Seminal plasma
 - (3) Urine (4) Semen
15. A process in which simple animals can grow into complete organisms from their cut body parts is
 - (1) Vegetative propagation
 - (2) Fragmentation
 - (3) Regeneration
 - (4) Spore formation
16. The fusion between the male and female gamete is called
 - (1) Syngamy (2) Triple fusion
 - (3) Double fertilization (4) Amphimixis
17. The period during which reproductive organs and tissues show maturation is called
 - (1) Menstruation
 - (2) Puberty
 - (3) Secondary sexual changes
 - (4) Adolescence

- 18.** Testosterone is produced by
 (1) Leyding cells
 (2) Interstitial cells
 (3) Seminiferous tubules
 (4) Both 1 and 2
- 19.** The common passage through which urine and sperms passes is called
 (1) Urethra (2) Uterus
 (3) Ureter (4) Urinary bladder
- 20.** The site of production of sperms in males is
 (1) Scrotum
 (2) Testis
 (3) Seminiferous tubules
 (4) Prostate
- 21.** The middle piece of mammalian sperms contains
 (1) Nucleus (2) Vacuole
 (3) Centriole (4) Mitochondria
- 22.** How may functional sperms are formed after spermatogenesis?
 (1) 8 (2) 4
 (3) 2 (4) 1
- 23.** Mature mammalian follicle is known as
 (1) Graffian follicle (2) Ovarian follicle
 (3) Corpus luteum (4) Corpus albicans
- 24.** The sac like structure into which the fertilized egg falls
 (1) Fallopian tube (2) Ovary
 (3) Vagina (4) Uterus
- 25.** Child birth is called
 (1) Pregnancy (2) Parturition
 (3) Menstruation (4) Menopause
- 26.** The life span of an unfertilized egg is
 (1) Two days (2) One hour
 (3) One day (4) One week
- 27.** The reproductive cycle in primate female is
 (1) Menstrual cycle
 (2) Oestrous cycle
 (3) Menopause
 (4) Puberty
- 28.** A cell formed from cleavage is called
 (1) Blastula (2) Morula
 (3) Gastrula (4) Blastomere
- 29.** Estrogen is secreted by
 (1) Corpus luteum
 (2) Graafian follicle
 (3) Ovary
 (4) Pituitary
- 30.** The secretion of progesterone by corpus luteum is initiated by:
 (1) FSH (2) LH
 (3) MSH (4) Thyroxine
- 31.** The process of release of ovum from ovary is known as
 (1) Gestation
 (2) Parturition
 (3) Ovulation
 (4) Implantation
- 32.** Endometrium is the lining of
 (1) Testis
 (2) Urinary bladder
 (3) Ovary
 (4) Uterus
- 33.** The fertilized ovum is transplanted in uterus after
 (1) 1 day (2) 7 days
 (3) 8 days (4) 10 days
- 34.** Select out the incorrect statement(s).
 A. Zygote undergoes a series of meiotic divisions called cleavage.
 B. The zygote is implanted in blastocyst stage on to the uterine wall.
 C. The rhythmic contractions of muscles in the uterus occurs in the presence of progesterone.
 D. The stoppage of menstruation is called menopause.
 (1) A only (2) C and D
 (3) A and C (4) B and D
- 35.** Polar bodies develop during
 (1) Spermatogenesis
 (2) Spermiogenesis
 (3) Oogenesis
 (4) Menstruation
- 36.** The hormone which prevents ovulation and formation of corpus luteum is
 (1) Progesterone (2) Estrogen
 (3) FSH (4) LH

37. The accessory gland present in females is

- (1) Bartholin's gland
- (2) Seminal vesicle
- (3) Prostate gland
- (4) Epididymis

38. Embryo at 16-celled stage is called

- (1) Morula
- (2) Blastula
- (3) Blastomere
- (4) Gastrula

39. Function of sertoli cells is controlled by

- (1) Estrogen
- (2) FSH
- (3) Testosterone
- (4) LH

40. Eggs produced in a year by an ovary of non-pregnant woman is

- (1) 12
- (2) 24
- (3) 48
- (4) 6

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Multiple fission is common in

- (1) *Hydra*
- (2) *Paramoecium*
- (3) *Plasmodium*
- (4) *Amoeba*

2. The common method of asexual reproduction is

- (1) Budding
- (2) Binary fission
- (3) Multiple fission
- (4) All 1, 2 and 3

3. Regeneration occurs in

- (1) *Planaria*
- (2) Lizards
- (3) Star fish
- (4) All the above

4. The common method of reproduction in *Plasmodium* is

- (1) Budding
- (2) Binary fission
- (3) Multiple fission
- (4) Regeneration

5. The plane of binary fission in *Amoeba* is

- (1) Transverse
- (2) Any plane
- (3) Oblique
- (4) Longitudinal

6. Gonads are the

- (1) Sex organs
- (2) Gametes
- (3) Sex hormones
- (4) Both 2 and 3

7. The spore bearing structure seen in bread mold is

- (1) Sporangium
- (2) Sporophyll
- (3) Sporophyte
- (4) Sori

8. The special tissue which connects between the mother and foetus is called

- (1) Villi
- (2) Placenta
- (3) Umbilical cord
- (4) Uterine wall

9. The region of female reproductive tract where fertilization occurs is

- (1) Vagina
- (2) Uterus
- (3) Cervix
- (4) Fallopian tube

10. The process of formation of ova is called

- (1) Ovulation
- (2) Oviparous
- (3) Oogenesis
- (4) Ovi position

11. Progesterone is secreted by

- (1) Corpus luteum
- (2) Placenta
- (3) Graafian follicle
- (4) Ovary

12. Part of sperm involved in penetrating egg during fertilization is

- (1) Tail
- (2) Acrosome
- (3) Head
- (4) Neck

13. Match the columns and find out the correct combination.

- | | |
|------------------------------------|--|
| A. Oxytocin | (i) Stimulates ovulation |
| B. Prolactin | (ii) Implantation and maintenance of pregnancy |
| C. LH | (iii) Uterine muscle contraction |
| D. Progesterone | (iv) Lactation |
| (1) A-(iii), B-(ii), C-(iv), D-(i) | |
| (2) A-(iii), B-(iv), C-(i), D-(ii) | |
| (3) A-(ii), B-(iii), C-(iv), D-(i) | |
| (4) A-(iv), B-(i), C-(ii), D-(iii) | |

14. Which among the following diseases is not sexually transmitted?

- (1) Syphilis
- (2) Hepatitis
- (3) HIV-AIDS
- (4) Gonorrhea

15. Reproduction is essential for living organisms in order to
 - (1) Keep the individual organisms alive
 - (2) Fulfill their energy requirement
 - (3) Maintain growth
 - (4) Continue the species generation after generation.
16. The lining of uterus which degrades during menstruation is
 - (1) Endometrium (2) Myometrium
 - (3) Perimetrium (4) Peritoneum
17. The gestation period in human female is
 - (1) 320 days (2) 200 days
 - (3) 270 days (4) 290 days
18. Pregnancy occurs only during
 - (1) Ovulation phase (2) Menstrual phase
 - (3) Proliferative phase (4) Secretory phase
19. Sperm duct in males is
 - (1) Vasa efferentia (2) Ejaculatory duct
 - (3) Epididymis (4) Vas deferens
20. The phase during which there occurs higher levels of estrogen and LH is called
 - (1) Proliferative phase (2) Menstrual phase
 - (3) Ovulation phase (4) Secretory phase
21. Prevention of pregnancy is called
 - (1) Contraception (2) Conception
 - (3) Abortion (4) Sterilization
22. An organism which can reproduce by both budding and regeneration
 - (1) *Amoeba* (2) *Hydra*
 - (3) *Yeast* (4) *Rhizopus*
23. Birth canal is known as
 - (1) Cervix (2) Uterus
 - (3) Vagina (4) Both 1 and 3
24. Choose the incorrect statement.
 - (1) Proliferative phase occurs under the influence of hormone FSH.
 - (2) The mature ovarian follicle is called Graffian follicle.
 - (3) Ovulatory phase occurs due to the influence of estrogen.
 - (4) Menstrual phase begins due to degeneration of corpus luteum and non secretion of progesterone.
25. The number of chromosome in human male germs cell and sperms respectively are
 - (1) 46 and 23 (2) 46 and 46
 - (3) 23 and 46 (4) 23 and 23
26. The small cells formed during meiosis in female germ cells which do not have the ability to reproduce are
 - (1) Oogonia (2) Polar bodies
 - (3) Primary oocytes (4) Secondary oocytes
27. The fluid produced by amnion sac is
 - (1) Plasma (2) Serum
 - (3) Seminal fluid (4) Amniotic fluid
28. The placenta functions as
 - (1) A protective barrier between mother and embryo.
 - (2) Supply oxygen and nutrients for growth of embryo.
 - (3) Expel the waste matter excreted by the embryo.
 - (4) All 1, 2 and 3.
29. The stage during which menstruation stops in adult females is
 - (1) Menopause (2) Menarche
 - (3) Mensus (4) Puberty
30. Development of foetus takes place in the
 - (1) Ovary (2) Oviduct
 - (3) Uterus (4) Vagina
31. An unfertilized human egg would have
 - (1) Two X-chromosome
 - (2) One X-chromosome
 - (3) One Y-chromosome
 - (4) Both X and Y chromosome
32. Consider the statements.
 - A. Condom, diaphragm and cervical caps are the common barriers used to prevent pregnancy.
 - B. Oral pills and vaginal pills are the chemical method practiced for prevention of pregnancy.
 - C. Intra Uterine Contraceptive Devices (IUCDs) prevent implantation in the uterus.
 - D. Vasectomy and tubectomy are the surgical methods practiced for birth control.

The correct ones are given in

 - (1) A, B, C and D
 - (2) B, C and D
 - (3) A and D
 - (4) C and D

33. Which is an accessory reproductive gland in males?
 (1) Gastric gland (2) Pituitary gland
 (3) Thyroid gland (4) Prostate gland
34. The hormone which induces spermatogenesis is
 (1) ADH (2) FSH
 (3) Estrogen (4) Aldosterone
35. Mammals which lay eggs are
 (1) *Platypus* and *Draco*
 (2) *Echidna* and bats
 (3) *Macropus* and *Echidna*
 (4) *Platypus* and *Echidna*
36. Human semen consists of
 (1) Sperms
 (2) Secretion of accessory sex glands
 (3) Fructose, Ca^{2+} , enzymes
 (4) All 1, 2 and 3
37. Select the wrong statement.
 (1) Ovary is also known as womb.
 (2) Expanded funnel like part of oviduct is called infundibulum.
- (3) Opening of vagina is covered by a partial membrane called hymen.
 (4) Fimbriae help in the collection of ovum after ovulation.
38. Both LH and FSH attain a peak level
 (1) At the beginning of menstrual cycle
 (2) At the middle of menstrual cycle.
 (3) At the end of menstrual cycle
 (4) During pregnancy
39. Which one is not correct about oral contraceptives?
 (1) Oral contraceptive are purely hormonal preparations.
 (2) It acts on hypothalamus, pituitary and ovaries.
 (3) It inhibits the production of gametes.
 (4) It inhibits the motility of sperms.
40. In mammary gland, the milk is secreted and stored in
 (1) Alveoli
 (2) Mammary tubule
 (3) Mammary duct
 (4) Lactiferous duct

ANSWER KEYS

PRACTICE EXERCISE 7 (A)

1. 2	2. 4	3. 3	4. 2	5. 4	6. 1	7. 2	8. 4	9. 2	10. 3
11. 1	12. 3	13. 2	14. 4	15. 3	16. 1	17. 2	18. 4	19. 1	20. 3
21. 4	22. 2	23. 1	24. 4	25. 2	26. 3	27. 1	28. 4	29. 2	30. 2
31. 3	32. 4	33. 2	34. 3	35. 3	36. 1	37. 1	38. 1	39. 2	40. 4

PRACTICE EXERCISE 7 (B)

1. 3	2. 1	3. 4	4. 3	5. 2	6. 1	7. 1	8. 2	9. 4	10. 3
11. 1	12. 2	13. 2	14. 2	15. 4	16. 1	17. 3	18. 1	19. 4	20. 3
21. 1	22. 2	23. 4	24. 3	25. 1	26. 2	27. 4	28. 4	29. 1	30. 3
31. 2	32. 1	33. 4	34. 2	35. 4	36. 4	37. 1	38. 1	39. 4	40. 1

Evolution and Genetics

GENETICS

- **Genetics** is the branch of science that deals with study of heredity and variations.
- **Heredity** is the transmission of genetic characters from parents to offsprings or one generation to the next.
- **Variations** are differences present in morphological, physiological and other traits found among individuals belonging to the same species.
- The variations result due to mutations occurring during DNA replication.
- **Mutations** are **sudden inheritable variations**.
- **Gregor Johann Mendel** is considered as the '**Father of Genetics**' and he conducted his experiments on **garden pea**, *Pism sativum*.
- Mendel studied the inheritance of **7 pairs of contrasting characters** in **pea plants**.
- The colour of the flower (red, white), seed colour (yellow, green), shape of the seed (round, wrinkled) height of the stem (tall, dwarf) etc. were the contrasting characters selected for hybridization.
- From the experiments on pea plants, Mendel formulated certain laws. These are known as **Mendel's laws of inheritance**.
- The **rediscovery of Mendel's work** was done by three scientists. **Hugo de Vries**, **Carl Correns** and **Erich Von Tschermak**.
- Mendel conducted crosses involving traits of a **single character** as **monohybrid** cross and involving traits of **two characters** as **dihybrid cross**.
- The offsprings formed in a cross are called **hybrids**.
- Mendel arrived at certain interferences from his experiments.
- A **pair of factors** responsible for each character is present in all organisms.
- One factor in each pair is received from the mother and other from the father.
- Factors of both the contrasting characters will be present in F_1 generation, but only one character will be expressed.
- The term **factor** has been replaced by gene by **Johannsen** in 1909.
- **Gene** is a unit of inheritance which consists of a segment of DNA that takes part in expressing a particular character.
- **Alleles** are **alternate forms of a gene** which occur at same locus on the chromosome.
- The external observable characters of an individual is called **phenotype** and the gene complement of an individual is **genotype**.
- A **factor** or allele which **can express its effect** whether present in homozygous or heterozygous state is called as **dominant factor**.

- A **factor** or allele which is **unable to express** its effect in the presence of dominant factor is called **recessive factor**.
- Monohybrid **phenotypic ratio** is **3:1** and **genotypic ratio** is **1: 2: 1**
- Dihybrid **phenotypic ratio** is **9: 3: 3: 1** whereas **genotypic ratio** is **1: 2: 1: 2: 4: 2: 1: 2: 1**.

Mendelism

- **Law of Dominance** states that when a pair of contrasting characters combines, only one is **expressed** and other **remains hidden**. The expressed factor is **dominant** where as hidden one is **recessive**.
- **Law of segregation** states that during gametogenesis, the pair of hereditary factors that determine the characters segregate from each other and only one factors enter each gamete.
- **Law of Independent Assortment** states that when two or more pairs of characters combine, factors for each character pair segregate and assort independently transmit to next generation.

Sex Determination

- In human beings and other animals, there are **two types of chromosomes** as **autosomes** and **allosomes**.
- **Autosomes** are the chromosomes which control **normal characters of the body**.
- **Allosomes** determine the **sex** of the individual. Allosomes are also called **sex chromosomes**.
- Human beings have 23 pairs of chromosomes of which **22 pairs** are **autosomes** and the **remaining pair** as **sex chromosomes**.
- In female, the two sex chromosomes are similar and called **XX-chromosomes**.
- They are **homogametic** and produce one type of gamete only.
- In males, **two types of sex chromosomes** are present as **X and Y**.
- They are **heterogametic** producing two types of gametes.
- **Sex of a child is determined** by the **type of sperms** fusing with the egg (by the **father only**).
- If an X-containing sperm fuses with egg, the child becomes female whereas if Y-containing sperm fuses with egg, the child becomes male. There is 50:50 chance of a boy or girl being born to every couple.
- Changes can occur in the numbers of autosomes and sex chromosomes and result abnormalities.

- **Down's syndrome** is due to an **extra-chromosome** (three chromosome in 21st pair) resulting in **47 chromosomes**.
- Mental retardation, sterility, low immunity are the symptoms of Down's syndrome.
- **Turner's syndrome** results due to the **loss of one sex chromosome**.
- Only one X-chromosome is present in such a person.
- The individuals are females with mental retardation, under developed and sterile.
- Total number of **chromosomes** is **45** in **Turner's syndrome**.
- **Klinefelter's syndrome** results due to the presence of an **additional Y chromosome** making the total number of **chromosomes 47**.
- Such individuals are males with mental retardation and sterility.

Nucleic Acids

- Nucleic acids are long polymers of nucleotides.
- **Friedrich Meischer** in **1869** discovered nucleic acid and termed it as '**nuclein**'.
- In **1902**, **Walter. S. Sutton** and **Theodore Boveri** discovered the hereditary factors are located on chromosomes.
- In **1905**, **William Bateson** named the branch of science. **Genetics**.
- In **1943**, **Oswald Avery**, **Mac Loed** and **Mc Carty** identified DNA as the genetic material.
- DNA and RNA are the two types of nucleic acids.
- In 1953, **James Watson** and **Francis Crick** elucidated the **double helical** model of DNA.
- In 1970's **Marshall Nirenberg** and **Har Gobind Khorana** discovered the **genetic code**.
- DNA molecule is formed of two strands of nucleotides and is made up of **sugar** and **phosphate** as longitudinal strands and the steps made by **nitrogenous bases**.
- A nucleotide is made up of three components: **Ribose sugar**, a **phosphate group** and **nitrogen base**.
- Nitrogen bases may be **purines** or **pyrimidines**. Purines are **adenine** and **guanine** where as pyrimidines are **cytosine** and **thymine**.
- **Purines** always **pairs with pyrimidines**.
- **Adenine** always **pairs with thymine** whereas **guanine** **pairs with cytosine**.
- Specific parts of DNA are responsible for regulating metabolism and effecting specific characters. These parts are known as **genes**.

- Genes are said to be expressed when proteins are formed.
- **DNA makes RNA** by the process of **transcription** and **RNA reaches ribosomes** and **synthesizes proteins** by linking together with various amino acids. This process is called **translation**.
- Information for the synthesis of specific proteins is encoded in each gene.
- **RNA** (Ribonucleic acid) also serves as genetic **material** especially in **certain viruses**.
- **RNA** differs from **DNA** in possessing only a **single strand**, thymine replaced by **uracil** and **ribose sugar** instead of 2-deoxyribose sugar.

Genetic Abnormalities

- Spontaneous changes in the structures and number of chromosomes are known as **mutations**.
- **Sickle cell anaemia** is a **gene mutation** or **point mutation** disorder seen in human beings.
- Sick cell anaemic persons show **sickle-shaped RBCs** along with normal RBCs.
- **Sickle-shaped RBCs** decrease the **oxygen carrying capacity of blood** and causes **severe anaemia**. It is common in tribals.
- **Haemophilia** and **colour blindness** are the sex **chromosome (X-chromosome)** related **mutation disorders** seen in humans.
- **Haemophilia** and **colour blindness** are **more common** and **prone to males** than females in humans.
- Haemophilia shows **inability of blood clot** due to the **absence of clotting factor** production.
- **Colour blind** persons are **not able to distinguish** red-green colour.
- Majority of the **mutated genes** are **recessive** in nature.
- **Turner's syndrome**, **Klinefelter's syndrome** and **Down's syndrome** are due to the chromosomal number variations.
- **Turner's syndrome** is common in female with only one X-chromosome, hence total number of chromosomes is 45 (**44 autosomes + 1 allosome**), i.e., **44 + X**.
- **Dwarfness** and **sterility** are the characters of Turner's syndrome.
- **Kline felter's syndrome** is common in males with an **extra X-chromosomes** (sex chromosome), hence show **44AA + XXY** configuration with **47 chromosomes**.
- **Mental retardation**, **sterility**, **low immunity** etc., are the features of **Down's syndrome**.
- **45 + XX** or **45 + XY** is the genetic nature of **Down's syndrome** patient.

Genetic Engineering and Related Products

- The **genetic manipulation** achieved by **introducing new genes into an organism's DNA** for useful products is known as **genetic engineering**.
- **Genetically modified organisms (GMOs)** are also known as **transgenics**.
- *Bt.cotton*, *Bt.brinjal*, *Bt.soyabean*, *Bt.tomato* etc., are **transgenic plants**.
- **Insulin producing E.coli** bacterium is another **transgenic microbe**.
- *Pseudomonas putida* is the genetically modified bacterium developed by **Ananda Mohan Chakrabarty**. Commonly known as Super bugs, capable **degradation of oil spills**.

Human Genome Project (HGP)

- **DNA sequencing of human chromosomes** is known as **Human Genome project (HGP)**.
- HGP helps to **identify the total genes** (approximately 30,000 genes) and each **gene's** specific genetic role.
- The **largest human gene** being identified is **dystrophin** having **2.4 million bases**.

Evolution

- It is the development of new types of organisms from the pre-existing ones through modifications.
- Modifications occur due to accumulation of variations.
- **Variations** develop **due to mutations** during DNA replication, gametogenesis, crossing over in meiosis. These are **genetic variations**.
- Certain variations develop during life time of an organisms. These are called **acquired variations**.
- Acquired variations are **non-heritable**.

Origin of Life

- Life originated on earth through **chemical reactions** or formation and coming together of biochemicals. It is called the theory of **chemical evolution**.
- In 1924, the Russian scientist **Oparin** and British scientist **J.B.S. Haldane** formulated the theory of chemical evolution and concluded that **life originated** from **non-living components**.

- Earth's atmosphere was **highly reducing** and always **exposed to ultra violet radiations**, cosmic rays, lightening and volcanic eruptions in earlier.
- Gases like **hydrogen, ammonia, water vapour and methane** that were present in the **reduced atmosphere** of primitive earth **reacted together** to form **simple organic molecules** like sugars, aminoacids, alcohols, fatty acids, nucleic acids etc.
- The simple organic molecules undergo further interactions and polymerization to form **complex organic molecules**. This results **coacervates** that developed to produce **protocells** or primitive cells.
- In 1953, **Stanley Miller** and **Harold Urey** recreated the conditions of primitive earth in the laboratory.
- They took a mixture of **ammonia, methane** and **Evihydrogen** and **water** and exposed it to electric sparks.
- The experiment resulted in the formation of organic compounds like **sugars, aminoacids, organic acids, purines and pyrimidines**.

Theories on Evolution

- The 'Theory of Inheritance of Acquired Characters' was proposed by French biologist **Jean Baptist Lamarck** and is known as **Lamarckism**.
- Lamarck's Theory relied on the **use or disuse** of **organs**, which changed the structure of organs. This was transmitted to the next generation which gave rise to new species of organism.
- The **long neck of giraffes** and **snakes without limbs** are cited as the examples of **Lamarck's use and disuse theory**.
- The 'Theory of inherited traits' was put forth by the famous naturalist, **Charles Darwin**, who is considered to be the '**Father of Evolution**'.
- Charles Darwin began his voyage in his survey ship **H.M.S. Beagle** in 1831 to **Galapagos Islands** at South America.
- In Galapagos Islands, he found different species of **finches (sparrow like birds)** having **varied forms of beaks, size and food habits**. All of them were related to finches on the mainland.
- There are 13 types of finches in 15 Islands. **Finches** were **similar in sound and nesting habits** but showed differences in beaks and food habits.
- Darwin also studied on **Galapagos Tortoises** and on **Iguanas** belonging to the class Reptilia.
- Darwin formulated the theory of evolution in his book, '**The Origin of Species**'.

- The British naturalist **Alfred Russel Wallace** also arrived at Darwin's interferences on evolution. He conducted his studies in Indonesian islands.
- 'Theory of Natural selection' also known as **Darwinism** states that organic evolution occurs through **natural selection** and accumulation of **inheritable variations** made them successful for their **survival and reproduction**.
- The important features of the theory are **overproduction, limited resources, struggle for existence, variations, natural selection, survival of fittest** and finally formation of a new species.
- **Hugo de Vries** postulated the **mutation theory** which states that **sudden and heritable changes lead to evolution**.
- Another reason for the origin of new species is **isolation**.
- **Continental drift** and **natural calamities** are the reasons for isolation.
- The process of **formation of new species** is called **speciation**.

Evidences of Evolution

- Evidences may be **palaeontological** (fossils), **physiological and biochemical** and **comparative anatomical and morphological**.
- **Fossils** are direct evidences of evolutions and are remnants of an organisms obtaining from rocks, soil, ice etc. They remain preserved in the earth's crust.
- The branch of science which deals with fossils is called **Palaeontology**.
- Fossils are called **written documents of evolution**.
- The best example is the fossil of *Archaeopteryx*, which is considered as a **connecting link** between **birds and reptiles**.
- *Archaeopteryx* shows **beaks, feathers and wings like birds** and **reptilian characters** like **clawed fingers, teeth on both jaws and solid bones**.
- **Homologous** and **Analogous organs** provide anatomical and morphological evidences of evolution.
- **Homologous** organs are organs with **similar embryonic origin** but perform **different functions**. E.g., Fore hind of bat, whale, cheetah and man.
- **Analogous** organs are organs which **differ** in their **embryonic origin** but appear **similar in their structure and function**. E.g., Wings of birds and butterflies.

- **Vestigial organs** are **reduced** and **non-functional organs** present in some organisms which were **fully developed** and **functional** in **ancestors only**.
- Examples are the **nyctitating membrane** in human eyes, **tail bones**, **vermiform appendix**, **body hairs**, **wisdom teeth** and **canines**.

Origin and Evolution of Man

- The branch of science which investigates human evolution is known as **Palaeoanthropology**.
- **Eugene Dubois** a Dutch evolutionist in 1891 discovered *Homo erectus*, the most important **link of human evolution**.
- *Homo erectus* fossil is known as **Java Man**.
- **Donald Johanson**, palaeoanthropologist in 1971 discovered the **oldest fossil**, *Australopithecus* and the fossil become **popular as Lucy**.
- Humans belong to the **Order Primata** of class **mammalia**.
- **Prosimians**, **cercopithecoidea** and **Hominoidea** are the families of primates.
- **Family Hominoidea** comprises the man, chimpanzee, gorilla, gibbon, orangutans etc and is the **largest family**.
- The earliest of the primates which existed were *Dryopithecus* and *Ramapithecus*.
- *Dryopithecus* was more ape like and *Ramapithecus* was man like.
- These were supposed to have lived from 20 million, 40 million years ago.
- *Ardipithecus* is the **first ancestor of man** who is considered to have lived 4.4 mya. Their fossils were discovered from **Ethiopia**.
- *Australopithecus* fossils were discovered from south east Africa, Tanzania and Ethiopia.
- They were about 4 feet tall and **walked** nearly **upright**.
- They **ate fruits** and **hunted** with **stone weapons**.
- *Homo habilis*, is the **oldest fossil of genus Homo**, which expresses the biological and behavioural characteristics of **modern man**.
- These fossils were discovered from **Tanzania** and they had **practical knowledge** of **using weapons**.
- They were **vegetarians**.
- *Homo erectus* were considered to have lived 1.8 mya. Their fossils were found in **Java Islands**, Indonesia, so known as **Java man**. They were supposed to have **good intelligence** and **physical strength**. They used **advanced weapons** and **probably ate meat**.
- *Homo neandertalensis* (**Neandertal Man**) is **primitive man** whose fossils were formed in east and central Africa. They used **hides to protect their body** and lived about 50,000 mya.
- *Homo sapiens* known as **modern man** arose 75,000–10,000 years ago. They spread all over the earth and knew the art of **agriculture** and **domestication of animals**.

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the following statements.

- Law of dominance, law of segregation and law of independent assortment etc are the Mendelian principles.
- Recombination in the progeny level result due to crossing over of chromosomes in meiosis.
- Sex determining chromosomes are known as autosomes.
- X–Y mechanism of sex determination is seen in human beings.

The correct ones are given in

- A, B and C
- B, C and D
- A, B and D
- A, C and D

2. A breeding experiment studying a single trait is

- Monozygous
- Dizygous
- Diybrid
- Monohybrid

3. Which one of the following does not account for Mendelian conclusion?

- Dominance
- Purity of gametes
- Independant assortment
- Linkage

4. Identify and select the wrongly matched pair.

- Hybrid – Pure breeding progeny
- Incomplete – An exception to Mendelism dominance

- (3) Heredity – Transmission of characters from one generation to the next.
- (4) Allele – Alternate representation of a gene
5. The allele which does not express its effect in the hybrid is
 (1) Dominant (2) Recessive
 (3) Moderate (4) Passive
6. The monohybrid genotypic ratio is
 (1) 1:1 (2) 3:1
 (3) 1: 2: 1 (4) 9: 3: 3: 1
7. The recessive trait in pea plant is:
 (1) Violet flower colour
 (2) Tall stem
 (3) Wrinkled seed
 (4) Yellow coloured seed
8. The ABO blood grouping in man is an example
 (1) Codominance
 (2) Multiple allelism
 (3) Incomplete dominance
 (4) Both 1 and 2
9. Select the incorrect statement(s).
 A. Mendel's works were rediscovered by Hugo de Vries, Carl Correns and Erich Von Tschermak.
 B. Sutton and Boveri put forward the chromosomal theory of Inheritance.
 C. The term genetics was put forwarded by Bateson.
 D. Alfred Russel Wallace is considered as Father of Evolution.
- The incorrect ones are given in
 (1) D only (2) A and B
 (3) B and C (4) B and D
10. Which of the following is the principle of purity of gametes?
 (1) Law of dominance
 (2) Law of Independent Assortment
 (3) Law of segregation
 (4) Both (1) and (3)
11. Attached ear lobe in humans is
 (1) Recessive trait
 (2) Dominant trait
 (3) Homozygous trait
 (4) Heterozygous trait
12. The number of autosomes in humans is
 (1) 46 (2) 23
 (3) 22 (4) 44
13. The principle of independent assortment means:
 (1) Separation of characters of one parent.
 (2) Non-separation of characters of one parent.
 (3) Separation of characters of both parents together.
 (4) Combination of both parental characters.
14. A Mendelian experiment involved the hybridization between tall (T) pea plants with violet (W) flowers and dwarf (t) pea plant with white (w) flowers. The genetic makeup of the F_1 hybrid can be depicted as:
 (1) TT ww (2) TT Ww
 (3) Tt Ww (4) tt Ww
15. The fully dominant and recessive genotypes in the F_2 generation of monohybrid cross is:
 (1) $\frac{2}{4}$ each (2) $\frac{1}{4}$ each
 (3) $\frac{1}{16}$ each (4) $\frac{3}{4}$ each
16. The genes which show independent assortment are located on:
 (1) Same locus of homologous chromosomes.
 (2) Different chromosomes
 (3) Same chromosome
 (4) Different locus of homologous chromosomes
17. How many types of gametes are formed from an individual with genotype TtRr?
 (1) 2 (2) 6
 (3) 8 (4) 4
18. Nucleic acids are the polymers of
 (1) Nucleosides (2) Nucleotides
 (3) Nitrogenous bases (4) Sugars
19. Which of the following are the pyrimidine bases of DNA?
 (1) Cytosine and Thymine
 (2) Cytosine and Uracil
 (3) Guanine and Adenine
 (4) Adenine and Thymine
20. Choose the mismatched pair:
 (1) Nuclein – Friedrich Meischer
 (2) Double helix of DNA – Watson and Crick
 (3) Genetic code – Anand Mohan Chakrabarty
 (4) Gene – Johannsen

21. The process of formation of RNA from DNA is
 - (1) Transduction (2) Transcription
 - (3) Transversion (4) Transition
22. An egg involved in male child formation has the genetic constitution of
 - (1) 22 + X (2) 22 + Y
 - (3) 44 + XY (4) 44 + XX
23. The syndrome exhibiting trisomy in 21st chromosome is
 - (1) Cri du chat syndrome
 - (2) Turner's syndrome
 - (3) Klinefelter's syndrome
 - (4) Down's syndrome
24. The elongation of neck in giraffe is considered as an example of
 - (1) Lamarckism
 - (2) Mendelism
 - (3) Darwinism
 - (4) Neo-Darwinism
25. Homologous structures are
 - (1) Dissimilar in origin, similar in function.
 - (2) Dissimilar in origin and function.
 - (3) Similar in origin, dissimilar in function.
 - (4) Similar in origin and function.
26. Which one is not a vestigial organ in man?
 - (1) Vermiform appendix
 - (2) Epiglottis
 - (3) Nictitating members
 - (4) Wisdom teeth
27. Which of the following is a correct statement?
 - (1) Wings of bats and butterflies are analogous.
 - (2) Wings of bats and flippers of whales are analogous.
 - (3) Vestigial organs are the functional organs seen in adult humans.
 - (4) Mutations are sudden, non-heritable changes leading to evolution.
28. If the fossil of an organism is found in deep layers of earth, then we can predict that.
 - (1) The organism became extinct recently.
 - (2) The extinction of organism occurred years back.
 - (3) The time of extinction is not related to layers of earth.
 - (4) Cannot be determined
29. The author of the book 'Origin of Species' is
 - (1) Darwin (2) Wallace
 - (3) Oparin (4) Lamarck
30. Select the group which shares the maximum number of common characters.
 - (1) Two species of a genus
 - (2) Two genera of a family
 - (3) Two individuals of same species
 - (4) Two genera of two families.
31. Palaeontology is the study of
 - (1) Bones (2) Embryo
 - (3) Birds (4) Fossils
32. The direct evidence of evolutions are
 - (1) Homologous organs
 - (2) Analogous organs
 - (3) Vestigial organs
 - (4) Fossils
33. The primitive ancestor of elephant is
 - (1) *Pheomea* (2) *Stegodon*
 - (3) *Moretherium* (4) African elephant
34. The reptilian character observed in *Archaeopteryx*.
 - (1) Vertebral column extends up to the tail.
 - (2) Presence of feathered wings.
 - (3) Presence of beak
 - (4) Streamlined body.
35. The main features of Darwin's theory of evolution are
 - (1) Struggle for existence
 - (2) Natural selection
 - (3) Survival of the fittest
 - (4) All (1), (2) and (3)
36. Select the incorrect statement regarding human evolution.
 - (1) *Dryopithecus* are ape-like
 - (2) *Ramapithecus* are man-like
 - (3) The *Australopithecus* fossils were discovered from Australia.
 - (4) The oldest fossil of the genus, Homo is *Homo habilis*.
37. The fossil of human evolution known as Jawa man is
 - (1) Homo habilis
 - (2) Homo erectus
 - (3) Australopithecus
 - (4) Homo sapiens

38. Which is the common group that includes man and monkeys?

- (1) Hominidae (2) Prosimians
(3) Cercopithecoidea (4) Primates

39. Reasons for origin of new species include

- (1) Mutations
(2) Continental drift

(3) Natural calamities

(4) All (1), (2) and (3)

40. Theory of Acquired Characters was put forward by

- (1) Lamarck
(2) Hugo de Vries
(3) Darwin
(4) Wallace

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The number of pairs of contrasting pairs studied by Mendel in pea plants.

- (1) 2 (2) 5
(3) 7 (4) 9

2. On which plant did Gregor Johan Mendel conducted his experiments?

- (1) *Antirrhinum* (2) *Pisum sativum*
(3) *Lathyrus* (4) *Mirabilis*

3. Select the incorrect statement.

- (1) Each character of an individual is controlled by a unit factor.
(2) During gamete formation, the alleles do not segregate, so that each gamete receives both the pair of alleles.
(3) The various forms of genes occupying a bones on homologous chromosomes are called as alleles or allelomorphs.
(4) Locus is the position on chromosomes where genes are located.

4. The character which is expressed in both homozygous and heterozygous conditions is

- (1) Dominant (2) Recessive
(3) Phenotype (4) Genotype

5. The genetic nature of a true breeding plant is

- (1) Hemizygous (2) Heterozygous
(3) Homozygous (4) Both 1 and 3

6. Find out the incorrect match:

- (1) Natural selection – Charles Darwin
(2) Mutation Theory – Carl Correns
(3) Use and Disuse theory – Lamarck
(4) Chemical Evolution – Oparin and Haldane

7. The phenotypic ratio in a dihybrid cross is

- (1) 1: 1 (2) 1: 2: 1
(3) 3: 1 (4) 9: 3: 3: 1

8. Results of two or three factors crosses can be easily analysed by

- (1) Principle of segregation
(2) Principle of dominance
(3) Principle of independent assortment
(4) Both 1 and 2

9. The number of recombinant phenotypes formed during F_2 generation of dihybrid cross.

- (1) 6 (2) 10
(3) 4 (4) 2

10. A nucleotide comprises of

- (1) Nitrogen base
(2) Pentose sugar
(3) Phosphate
(4) All 1, 2 and 3

11. The number of gametes formed from a homozygous individual in a dihybrid cross.

- (1) Four (2) Two
(3) One (4) Six

12. A cross between a tall pea plant and dwarf pea plant resulted tall progenies in F_1 generation because

- (1) Tallness is a recessive trait
(2) Dwarfness is a dominant trait
(3) Tallness is a dominant trait
(4) Neither 'T' or 't' governs stem height.

13. A zygote which has an X-chromosome inherited from the father will become

- (1) Boy (2) Girl
(3) Either girl or boy (4) Cannot be predicted

14. A trait in an organism is influenced by
 (1) Paternal DNA
 (2) Maternal DNA
 (3) Both paternal and maternal
 (4) Neither Paternal nor Maternal
15. Two pea plants, one with yellow round seeds (YYRR) and another with green wrinkled seeds (yyrr) produce F_1 progeny that have yellow round seeds (Yy Rr). The possible new combinations in F_2 generation is.
 A. Yellow Round B. Yellow wrinkled
 C. Green Round D. Green wrinkled
 Correct ones are given in
 (1) A and B (2) B and C
 (3) C and D (4) A and D
16. Which of the following statements is incorrect?
 (1) For every hormone there is a gene.
 (2) For every protein there is a gene
 (3) For production of every enzyme, there is a gene.
 (4) For every molecule of sugar, there is a gene.
17. According to the theory of Darwinism, the survival of fittest individuals means
 (1) Organisms capable of indefinite growth.
 (2) Vigorous feeders.
 (3) Organisms resistant to natural calamities.
 (4) Maximum reproduction capacity.
18. Consider the following pairs.
 A. Haemophilia – X-linked genetic disorder
 B. Trisomy – An extra one chromosome seen along with diploid number of chromosomes.
 C. Holandric genes – Y-linked gene characters seen only in males
 D. Sickle cell anaemia – Heterozygous and autosomal related
 The correctly paired matchings are
 (1) A, B, C and D (2) A, C and D
 (3) B, C and D (4) A, B and D
19. The condition where the total number of chromosomes is 47.
 (1) Down's syndrome
 (2) Turner's syndrome
 (3) Klinefelter's syndrome
 (4) Both 1 and 3
20. The karyotype of an individual with Turner's syndrome is
 (1) 44 A + XX (2) 45 A + XY
 (3) 44 A + XO (4) 44 A + XXY
21. The technology that is used to make desired changes in gene structure is
 (1) Genetic engineering
 (2) Recombinant DNA technology
 (3) Gene cloning
 (4) All 1, 2 and 3
22. Males are heterogametic because
 (1) They can produce two types of gametes.
 (2) They produce two similar gametes
 (3) They are able to produce both egg and sperms.
 (4) Both 1 and 2
23. The karyotype of a normal male is
 (1) 22 AA + XY (2) 44 AA + XY
 (3) 22 A + XX (4) Both 1 and 2
24. In the experiment, Urey and Miller provided an electric discharge in a mixture of:
 (1) Ammonia, oxygen, steam, hydrogen.
 (2) Methane, hydrogen, nitrogen, steam.
 (3) Steam, methane, hydrogen, ammonia.
 (4) Carbon dioxide, oxygen, ammonia
25. Theory of panspermia accounts on the origin of life in earth.
 (1) Came as spores from outer space.
 (2) Came out of dead and decaying matter.
 (3) Comes only from pre-existing life.
 (4) From inorganic molecules.
26. Dinosaurs were abundant during
 (1) Devonian (2) Jurassic
 (3) Silurian (4) Carboniferous
27. The ultimate source of variation is
 (1) Adaptability (2) Sexual variation
 (3) Natural selection (4) Mutation
28. Life comes from pre-existing life was stated by
 (1) Louis Pasteur (2) Oparin
 (3) Darwin (4) Miller
29. Mutation as a reason for variation was proposed by
 (1) Charles Darwin (2) Lamarck
 (3) Hugo de Vries (4) Thomas Malthus

30. The first living cell is/are known as
 (1) Coacervates
 (2) Proto cell
 (3) Protobiont
 (4) Both 2 and 3
31. Consider the following human evolution:
 (i) *Dryopithecus*
 (ii) *Homo erectus*
 (iii) *Neanderthal man*
 (iv) *Australopithecines*
 The correct sequence of human evolution is
 (1) (i), (ii), (iii) and (iv)
 (2) (i), (iv), (ii) and (iii)
 (3) (iv), (iii), (ii) and (i)
 (4) (i), (iv), (iii) and (ii)
32. In evolutionary terms, we are more related to
 (1) Skull of baby chimpanzee
 (2) Adult chimpanzee
 (3) Gorilla
 (4) Ape
33. Darwin's finches show
 (1) Adaptive Radiation
 (2) Parallel evolution
 (3) Homology
 (4) Natural selection
34. Most of the fossils occur in rocks as
 (1) Metamorphic (2) Igneous
 (3) Sedimentary (4) All 1, 2 and 3
35. Sum total of genes in a population is
 (1) Genotype (2) Karyotype
 (3) Genetic constitution (4) Gene pool
36. Formation of new species from pre-existing species is
 (1) Mutation (2) Speciation
 (3) Isolation (4) Polyploidy
37. Galapagos islands were visited by
 (1) Wallace (2) Lamarck
 (3) Darwin (4) Malthus
38. Cranial capacity of modern man is
 (1) 450–650 cc (2) 600–1000 cc
 (3) 900–1100 cc (4) 1200–1600 cc
39. In *Homo habilis*, the term habilis refers to
 (1) Wandering Man (2) Tool maker
 (3) Ancient man (4) Modern man
40. Which of the following is more ape-like?
 (1) *Dryopithecus*
 (2) *Ramapithecus*
 (3) *Homo erectus*
 (4) *Homo neanderthalensis*

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

1. 3	2. 4	3. 4	4. 1	5. 2	6. 3	7. 3	8. 4	9. 1	10. 3
11. 1	12. 4	13. 3	14. 3	15. 2	16. 1	17. 4	18. 2	19. 1	20. 3
21. 2	22. 1	23. 4	24. 1	25. 3	26. 2	27. 1	28. 2	29. 1	30. 3
31. 4	32. 4	33. 3	34. 1	35. 4	36. 3	37. 2	38. 4	39. 4	40. 1

PRACTICE EXERCISE 8 (B)

1. 3	2. 2	3. 2	4. 1	5. 3	6. 2	7. 4	8. 3	9. 1	10. 4
11. 3	12. 3	13. 2	14. 3	15. 2	16. 3	17. 4	18. 1	19. 4	20. 3
21. 4	22. 1	23. 2	24. 3	25. 1	26. 2	27. 4	28. 1	29. 3	30. 4
31. 2	32. 1	33. 1	34. 3	35. 4	36. 2	37. 3	38. 4	39. 2	40. 1

Health and Hygeine

SYNOPSIS

- Balanced nutritive food, regular exercise, body cleanliness and neat surroundings are the basic requirements needed for good health.

Health

- **Health** is a state of **being well** physically, mentally and socially.
- A condition that affects the well being of an individual adversely is known as **disease**. The word **disease** means disturbed ease.
- Disease causes changes in the functioning or the appearance of one or more organ systems of the body. These changes may give rise to signs and symptoms of the disease.
- Diseases may be **acute** or **chronic**.
- **Acute disease** lasts only for **short periods** of time and may not cause major effects on general health.
- A **chronic disease** last for **longer time** and cause **major damages** to general health when compared to acute diseases.
- Disease may be infectious or non-infectious.
- **Infectious disease** is any change in a state of normal health in which part or whole body of an individual

does not function properly due to presence of an infectious agent and its products.

- The phenomenon of growth, multiplication and establishment of an infectious agent in host tissues or cells is known as **infection**.
- The **parasite** which causes the disease in an individual is called **pathogen**.
- **Epidemiology** is the science that deals with occurrence, determination, distribution and control of a disease.
- **Infectious disease** are characterized by signs and symptoms. These are caused by **viruses, protozoans, bacteria, fungi, protozoans** and **helminthic worms** and transmitted from one host to another. So, it is also called as **communicable disease**.
- **Non-infectious diseases** are not caused by infectious agents instead these are mostly internal with non-infectious causes. E.g., **cancer** caused due to genetic abnormalities and high **blood pressure** due to excessive weight and lack of exercise. These are **non-communicable diseases**.
- For the perpetuation of disease, survival of pathogens and the **transmission** from one host to another occurs by any of the four main routes: **air borne, contact, water borne, vehicle** and **vector borne**.
- In air borne transmission, the pathogens remain suspended in air and are transmitted through droplet.

The droplets remain in air for hours or days and are carried to individuals.

- The **common air borne disease** are **common cold, flu, chickenpox, measles, mumps, pneumonia, diphtheria, tuberculosis** etc.
- Diseases can **spread** through **water** and **food**. They enter our intestine and release **toxins** and result in disorders.
- The common food and water borne diseases are **cholera, typhoid, jaundice, dysentery** etc.
- Contact transmission occurs when the pathogen spread in contact with the host and the reservoir of pathogens, contact refers to person to person contact through touching, kissing or sexual contact.
- Common examples of **diseases** that **spread** through **contact** are **herpes, staphylococci infections, AIDS** and **syphilis**.
- The **AIDS virus** can also spread through **blood transfusion** and from **infected mother** to her **baby** during pregnancy.
- **Vehicle transmission** refers to the **transmission through inanimate** materials like towels, utensils, surgical instruments, needles etc.
- Vectors borne diseases are transmitted through a **pathogen carrier** or vector. It is also called as **biological transmission**.
- Vector borne diseases are **malaria, plague, dengue fever, chikunguniya, filaria** etc.

Bacterial Diseases

- **Tuberculosis** is an **air borne** disease caused by *Mycobacterium tuberculosis* bacterium. The bacterium infects the **respiratory tract** and establishes in lung tissues.
- **Diphtheria** is caused by *Corynebacterium diphtheriae* is a serious **air borne** disorder affecting the **respiratory tract**. The bacteria produce **diphtheria toxin** which causes **inflammation of the respiratory mucosa**.
- **Pneumonia** is caused by *Streptococcus pneumoniae* characterized by **alveoli filled** with **blood** and **fluid** which finally become inflamed.
- **Cholera** is caused by *Vibrio cholerae* acquired after taking **contaminated food** and **water**. It affects the **small intestine** and in turn reduces the absorption capacity.
- **Botulism** is a type of **food poisoning** caused by *Clostridium botulinum* an anaerobic bacterium. It produces a **toxin** that affects the **nervous system** and in turn leading to **paralysis**.

- **Dysentery or Shigellosis** is an inflammatory reaction of the **intestinal tract** caused by *Shigella* bacterium. The toxin secreted by the pathogen acts on **intestinal wall** and causes **diarrhoea**.
- **Typhoid fever** is caused by *Salmonella typhi* which commonly spreads through contaminated water. They colonize the small intestine and results in fever, headache, abdominal pain etc.
- **Tetanus** caused by *Clostridium tetani* is a disease which mainly **affects** the **respiratory system** and **gastro-intestinal tract**.
- **Anthrax** is caused by spore forming bacterium, *Bacillus anthracis* which mainly affects the respiratory system and gastro-intestinal tract.
- Sexually transmitted bacterial diseases are **Gonorrhea** (*Neisseria gonorrhoeae*), **syphilis** (*Treponema pallidum*) etc., where as physical contact disease comprises **leprosy** (*Mycobacterium leprae*).

Viral Disease

- The **common cold** is a **viral disease** caused by a group of viruses, known as *Rhinoviruses* which mainly affect the respiratory tract and lungs. It is mainly transmitted by droplets and contacts.
- **Influenza** or **flu** is a common viral disease caused by *Orthomyxo viruses* which spreads through droplets and infects the respiratory tract.
- **Small pox** is caused by a DNA virus *Variola* where the infections spreads from oral, nasal discharges and pustules.
- **First vaccination** developed by **Edward Jenner** was against **small pox** in 1796.
- **Chicken pox** is a contagious, eruptive viral disease. It is caused by the virus *Varicella zoster* and is characterized by rashes with **purplish coloured** spots.
- **Mumps** is highly infectious one time **viral disease** which is characterised by **swollen parotid salivary gland**. The pathogen is RNA containing *Paramyxo virus*. It is transmitted by direct contact and droplet methods. High fever chills, headache and anaemia are the symptoms.
- **Measles** is a highly infectious eruptive **viral disease** of children and is caused by RNA containing *Rubeola virus*. Disease is transmitted by contact and droplet methods. It is characterised by inflammation of respiratory tract, redness or watering of eyes, loss of appetite and fever etc.
- **Rabies** is a **fatal viral disease** that is **transmitted** to human beings by **biting** or through the **saliva** of a

rabid dog or **cat**. The virus is *Rhabdo virus* and their multiplication occurs in **neurons**. It leads to **encephalitis**, **fear of water**, severe headache, high fever etc. It is also known as **hydrophobia**.

- **Dengue fever** is a viral disease which is caused by viruses *DEN 1* and spread by female Tiger Mosquito or *Aedes albopictus*.
- **Chikunguniya** is a temporarily debilitating disease caused by *Alpha virus* and spread through mosquitoes, *Aedes aegypti*.
- **AIDS** (Acquired Immuno Deficiency Syndrome) is caused by a **retrovirus**. *Human Immuno deficiency Virus (HIV)*. It is transmitted by **sexual contact**, **blood transfusion** or from mother to her baby during pregnancy.
- In **HIV** infection, the **virus multiplies** in the **T-lymphocytes** and **suppresses** the **immune system** and damage its function. The patient becomes susceptible to all infections and gradually results in the death.

Fungal Diseases

- Fungal diseases in humans are **ringworm** infections of skin caused by species of *Trichophyton*, *Microsporum* and *Epidermophyton*.
- Ring worm shows dry scaly lesions on skin, nails and scalp that cause intense itching.
- Heat and moisture promote the growth of these fungi especially in skin folds.
- Common sources of infection are soil and towels, clothes, combs of infected persons.

Protozoan Diseases

- **Malaria** is a **communicable protozoan** disease of tropical and subtropical areas which is caused by species of *Plasmodium* and spread through **female Anopheles** mosquito.
- It is characterized by **recurring fever** lasting 6-10 hours and there are 3 stages as **cold state** (chill and shivering) **hot stage** (temperature rises) and **sweating stage** (perspiration and gradually fall in temperature).
- *Plasmodium* may be of different types: *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium falciparum* and *Plasmodium ovale*.
- *Plasmodium falciparum* causes malignant malaria.
- **Amoebiasis** is caused by a **protozoan** *Entamoeba histolytica* and is characterised by abdominal pain, alternating diarrhoea and constipation stool with blood and mucus. it is also called **amoebic dysentery**.

- **African sleeping sickness** is caused by *Trypanosoma*, a **flagellated protozoan** and is spread by the vector *Tse-tse* fly (*Glossinia palpalis*).
- The parasite multiplies inside the host blood, enters the lymphatic system and finally into cerebro spinal fluid.
- It release a **toxin** which **causes** complications in the **nervous system** and results in excessive drowsiness or sleep.

Helminthic Diseases

- *Ascariasis* is a worm disease caused by **round worm**, *Ascaris lumbricoides*. It affects the intestinal tract and causes digestive and absorptive problems.
- *Filariasis* or *Elephantiasis* is caused by the filarial worms, *Wuchereria malayi* and *Wuchereria bancrofti* causing a slowly developing chronic inflammation of the organs.
- It affects the lymphatic vessels of the lower limbs and also the genital organs resulting in gross deformities. The pathogens are transmitted by the bite of **female mosquito vectors**—*Culex*.
- **Rat fever**, scientifically known as *Leptospirosis* is a **viral fever** spread through the **urine** of rat, dog, cow etc.

Occupational Diseases

- **Diseases seen in people** who work in **certain fields** are known as **occupational disease**.
- **Silicosis** is an occupational disease seen in people working in **quaries**.
- **Asbestosis** is another occupational disease seen in people working in **asbestos manufacturing units**.
- **Allergies** and **Asthama** are common in polluted atmosphere with chemicals like **sulphurdioxide**, **dust** and **smoke**.
- Pollutants also cause **bronchitis**, **emphysema** and even **cancer**.

Principles of Treatment and Prevention

- **Vaccination** or **immunization** is based on the property of **memory of immune system**.
- In vaccination, a preparation of **antigenic proteins** of **pathogens** or **inactivated pathogens** are introduced into the body.
- The antibodies produced in the body against these antigens would neutralize the pathogenic agents during actual infection by activating the **B** and **T-lymphocytes**.

- **Edward Jenner** was the first person who tested **vaccination** against **small pox**.
- **Louis Pasteur** prove substantially that diseases are caused by micro-organisms and invented an effective **vaccine against anthrax and rabies**.
- The common vaccines are,
 - (1) **DPT vaccine** (Diphtheria, whooping cough/Per-tussis and Tetanus).
 - (2) **Polio salk vaccine**,
 - (3) **Hepatitis B vaccine**,
 - (4) **BCG** (Bacillus Calmette Guerin) vaccine against Tuberculosis.
 - (5) **TAB vaccine** against Typhoid and paratyphoid.
 - (6) **MMR vaccine** against Measles, Mumps and *Rubeola*.
- Treatment is the ultimate defenses strategy and several modes of treatment have been developed in different countries like **Ayurveda, Homeopathy, Allopathy and Modern Medicine** etc.
- Modern medicine is a branch of medicine that was introduced by the ancient Greek Physician, **Hippocrates** which gives much **importance of diagnosis, treatment and medicines** etc.
- **Chemotherapy** was first introduced by **Paul Ehrlich**.
- **Alexander Fleming** invented the medicines from micro-organisms. The best example was the discovery of **penicillin**, the **first antibiotic drug** isolated from the fungus, *Penicillium notatum*.
- Maintenance of personal and public hygiene is very important for the prevention and control of many infectious diseases.
- Measures for personal hygiene include keeping the body clean, consumption of clean drinking water, food, vegetable, fruits etc.
- Public hygiene includes proper disposal of wastes and excreta, periodic cleaning and disinfections of water

reservoirs, pools and tanks and observing standard practices of hygiene in public catering. These measures are particularly essential when and where the infectious agents are transmitted through food and water such as typhoid, amoebiasis, ascariasis, jaundice etc.

Cancer

- **Cancer** is a group of **non-communicable disease** characterized by **uncontrolled proliferation of cells** and **ability of proliferated cells to invade** other parts of the body.
- **Tumors** are **swellings or growth** caused by **abnormal proliferation of cells** and it is of two types: **benign** and **malignant**.
- **Benign tumor** is a **large localized mass** of abnormal tissues whereas **malignant tumor** is capable of **invading adjacent tissues** and **distant sites** of body.
- **Metastasis** is the **spread of cancerous** cells from one part of the body to other parts through blood, lymph etc.
- Cancers are of different types:
 1. **Carcinoma** (cancer of epithelial/epidermal tissue).
 2. **Sarcoma** (cancer of mesodermal tissue).
 3. **Leukemia** (Increase in the number of white blood corpuscles).
- **Cancer causing** agents are called **carcinogens** which include **radiation, chemicals, viruses** etc.
- **Alcohol, tobacco** and **pan masala** are also cause **cancer** in humans.
- **Alcohol** causes **cancer** in **alimentary canal** and **liver cirrhosis**.
- **Tobacco smoking** causes **bronchitis**.
- **Pan masala** cause **oral cancer**.
- **Cancer causing genes** are known as **oncogenes**.

PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the following matched pairs.

- A. Cholera, tuberculosis – Bacterial disease and typhoid
- B. Polio, rabies and chicken pox – Viral diseases

- C. Diarrhoea and gastroenteritis – Protozoans, bacteria or viral diseases

- D. Ascariasis and filariasis – Helminth diseases

The correctly paired groups are given in

- (1) A, C and D
- (2) B, C and D
- (3) A, B and C
- (4) A, B, C and D

2. Which of the following diseases are transmitted through air?
 - (1) Typhoid, cholera and pneumonia
 - (2) Diarrhoea, tuberculosis and pneumonia
 - (3) Tuberculosis and pneumonia
 - (4) Rabies, chicken pox and polio
3. Consider the statements.
 - A. Oral Rehydration Solution (ORS) should be given to cholera or diarrhoea patients at regular intervals.
 - B. *Poliovirus* is transmitted through food or water and ultimately affect central nervous system.
 - C. *E.coli* and *Shigella* bacteria are responsible for Diarrhoea disease.
 - D. *Rhino viruses* are responsible for common cold.
 The correct statements are
 - (1) A and D
 - (2) A, B, C and D
 - (3) A, C and D
 - (4) A, B and D
4. A pathogen which cannot be cultured on nutrient medium is:
 - (1) Bacterium
 - (2) Protozoan
 - (3) Virus
 - (4) Fungus
5. Droplet infection is a mode of
 - (1) Direct transmission
 - (2) Indirect transmission
 - (3) Vector mediated
 - (4) Food transmission
6. The disease known as hydrophobia is
 - (1) Rabies
 - (2) Tetanus
 - (3) Syphilis
 - (4) Cholera
7. A disease transferred from mother to child through placenta is
 - (1) Genital warts
 - (2) Syphilis
 - (3) Trichomoniasis
 - (4) AIDS
8. A disease spread indirectly through a vector is
 - (1) Sleeping sickness
 - (2) Malaria
 - (3) Kala-azar
 - (4) All 1, 2 and 3
9. Which of the following is a bacterial disease?
 - (1) Measles
 - (2) Tuberculosis
 - (3) Chicken pox
 - (4) Rabies
10. Bacterium which causes diphtheria belongs to
 - (1) *Bacillus*
 - (2) *Diplococcus*
 - (3) *Corynebacterium*
 - (4) *Vibrio*
11. Sexually transmitted disease (STD) is
 - (1) Syphilis
 - (2) Leprosy
 - (3) Diphtheria
 - (4) Tetanus
12. Select the incorrect statement.
 - (1) Disease literally means disturbed ease.
 - (2) The phenomenon of growth, multiplication and establishment of an infections agent in host cells is known as infection.
 - (3) The parasite which causes the disease in an individual is called host.
 - (4) Epidemiology is the science that deals with occurrence, distribution and control of a disease.
13. DPT vaccine is given to protect the diseases like
 - (1) Diphtheria, polio and tuberculosis
 - (2) Diphtheria, whooping cough, tetanus
 - (3) Diarrhoea, polio, tetanus
 - (4) Diarrhoea, pertussis, tuberculosis
14. The disease characterized by oozing of semi solid material in throat forming a tough membrane is
 - (1) Whooping cough
 - (2) Diphtheria
 - (3) Pulmonary tuberculosis
 - (4) Measles
15. A disease which often produces deformities of fingers and toes is
 - (1) Poliomyelitis
 - (2) Leprosy
 - (3) Typhoid
 - (4) Filariasis
16. The disease mumps is
 - (1) Inflammation of tensil
 - (2) Infection of skin
 - (3) Cancer of cheeks
 - (4) Inflammation of salivary glands
17. *Entamoeba histolytica* is found in
 - (1) Rectum
 - (2) Intestine
 - (3) Stomach
 - (4) Oral cavity
18. Malignant malaria is caused by
 - (1) *Plasmodium vivax*
 - (2) *Plasmodium ovale*
 - (3) *Plasmodium malariae*
 - (4) *Plasmodium falciparum*
19. Filariasis is also known as elephantiasis because
 - (1) Infection mainly seen in elephants.
 - (2) Elephants are secondary hosts.

- (3) Excessive enlargement of body parts like legs of elephants.
(4) Excessive enlargement of teeth.
20. The substance that tends to produce cancer is known as
(1) Oncogene (2) Carcinoma
(3) Carcinogen (4) Metastasis
21. The process of vaccination was discovered by
(1) Edward Jenner (2) Robert Koch
(3) Louis Pasteur (4) Alexander Fleming
22. A substance produced by the host in response to an infection or foreign structure is
(1) Antigen (2) Toxin
(3) Hormone (4) Antibody
23. A non-specific immunity is
(1) Passive immunity (2) Active immunity
(3) Auto immunity (4) Innate immunity
24. The cells of immune response are produced in
(1) Liver (2) Spleen
(3) Bone marrow (4) Lymph nodes
25. Diphtheria is associated with
(1) Throat (2) Lungs
(3) Blood (4) Liver
26. The germ *Mycobacterium* causes
(1) Leprosy (2) Tuberculosis
(3) Whooping cough (4) Both 1 and 2
27. The disease known as 'Black Death' is
(1) Kala-Azar (2) Plague
(3) Sleeping sickness (4) AIDS
28. Which one of the following disease is caused by nematode?
(1) Poliomyelitis (2) Leprosy
(3) Filariasis (4) Amoebiasis
29. The vector that spreads the sleeping sickness is
(1) Tse-tse fly (2) *Anopheles* mosquito
(3) Tiger mosquito (4) *Aedes aegypti*
30. Select the wrong pair from the following.
(1) Gonorrhea – Virus
(2) Plague – *Yersinia pestis*
(3) AIDS – *Human Immuno deficiency Virus*
(4) Syphilis – Ring worm disease
31. AIDS spreads through
(1) Blood transfusion (2) Placental tissue
(3) Sexual intercourse (4) All 1, 2 and 3
32. A disease on the verge of extinction in India is
(1) AIDS (2) Kala-azar
(3) Poliomyelitis (4) Measles
33. *Salmonella* bacterium causes
(1) Polio (2) Tuberculosis
(3) Tetanus (4) Typhoid
34. AIDS day is considered in
(1) June 1 (2) December 1
(3) May 1 (4) August 20
35. Consider the statements.
A. Immunity means the ability of a body to recognize, destroy and eliminate external disease-causing agents.
B. Vaccination helps a person to acquire immunity against a certain disease.
C. Vaccine is a solution containing the disease causing organisms in a diluted or weakened form.
D. The commonly used vaccines are DPT, BCG, Hepatitis vaccine, Polio vaccine, Typhoid vaccine etc.
The correct statements are given in
(1) Lysozyme (2) Lipase
(3) Protease (4) Reductase
36. Inflammatory reactions in allergy are brought about by
(1) Macrophages (2) Plasma cells
(3) Adipose cells (4) Mast cells
37. Father of Immunology is
(1) Robert Koch (2) Edward Jenner
(3) Louis Pasteur (4) Paul Ehrlich
38. B. C. G. is a vaccine practiced against
(1) Typhoid (2) Tetanus
(3) Tuberculosis (4) Measles
39. Ringworm diseases in humans are caused by
(1) Fungi (2) Nematodes
(3) Viruses (4) Round worms
40. Vaccine against rabies was first developed by
(1) Edward Jenner (2) Paul Ehrlich
(3) Louis Pasteur (4) Alexander Fleming

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. A viral disease causing painful swelling in the salivary glands is
 - (1) Measles (2) Mumps
 - (3) Typhoid (4) Cholera
2. The protozoan organism that causes kala-azar is
 - (1) *Leishmania* (2) *Ascaris*
 - (3) *Trypanosoma* (4) *Entamoeba*
3. A chronic disease means it
 - (1) Lasts for a long time
 - (2) Occurs from the time of birth
 - (3) Lasts for a short time
 - (4) Both (2) and (3)
4. SARS and Swine flu diseases are caused by
 - (1) Virus and protozoan
 - (2) Virus and bacterium
 - (3) Viruses
 - (4) Virus and helminth
5. Ascariasis spreads through
 - (1) Vectors
 - (2) Air and physical contact
 - (3) Contaminated food and water
 - (4) Droplets seen in air
6. The spread of cancer cells to other parts of the body is known as
 - (1) Metamorphosis
 - (2) Metastasis
 - (3) Metagenesis
 - (4) Metamerism
7. A communicable disease is generally caused by
 - (1) Metabolic disorder (2) Hormonal imbalance
 - (3) Allergy (4) Pathogen
8. *Helicobacter pylori* causes
 - (1) Peptic ulcers (2) Cholera
 - (3) Tuberculosis (4) Mumps
9. The antibiotic works on the principle as
 - (1) It makes the immune system of patients strong and make him/her resistant to the infection.
 - (2) It eliminates the vector of a disease.
 - (3) It blocks the biochemical pathway important for the growth of the pathogen.
 - (4) It contains important factors to fight against diseases.
10. AIDS virus cannot be transmitted by:
 - (1) Sharing needles and syringes
 - (2) Hugs and hand shakes
 - (3) Sexual contact
 - (4) Blood transfusion
11. Which of the following diseases has been eradicated by vaccination?
 - (1) Polio (2) Chicken pox
 - (3) Small pox (4) Kala-azar
12. Mosquitoes should not be allowed to breed in the surroundings because:
 - (1) They are vectors of many disease
 - (2) They cause a number of disease
 - (3) They divide fast and cause pollution
 - (4) They spoil water and its resources.
13. Which of the following diseases are classified as acute diseases?

A. Tuberculosis	B. Cancer
C. Common cold	D. Viral fever

 The correct one is
 - (1) B and C (2) B and D
 - (3) A and B (4) A and D
14. It is difficult to make anti-viral drugs because
 - (1) Viruses use the host cell as machinery to grow and divide.
 - (2) Viruses are surrounded by protein coat.
 - (3) Viruses are on the borderline of living and non-living state.
 - (4) Viruses are very small in size.
15. Which of the following statements is incorrect?
 - (1) AIDS can be prevented by taking precautions and avoiding safe sexual contact.
 - (2) Prevention is better than cure.
 - (3) Treatment is better than prevention.
 - (4) Vaccination provides protection against specific diseases.

16. Clean drinking water is related to
 (1) Personal hygiene
 (2) Public hygiene
 (3) Economic status
 (4) Social status
17. If a person lives in an over crowded and purely ventilated house, it is possible that he may suffer from the disease
 (1) Airborne diseases (2) Cholera
 (3) Cancer (4) AIDS
18. Which of the following is not transmitted by mosquitoes?
 (1) Dengue (2) Malaria
 (3) Rat fever (4) Pneumonia
19. Which of the following can make you ill if you come in contact with an infected person?
 (1) High blood pressure
 (2) Common cold
 (3) Cancer
 (4) Genetic abnormalities
20. Vectors can be defined as
 (1) Microorganisms which may cause disease
 (2) Infected persons
 (3) Animals carrying the infectious agents from a sick person to another healthy person.
 (4) Diseased plants.
21. *Ascaris lumbricoides* is a common round worm seen in
 (1) Large intestine (2) Small intestine
 (3) Liver (4) Stomach
22. Which of the following is wrong regarding tuberculosis?
 (1) It commonly affects the lungs
 (2) Bacteria releases tuberculin toxin
 (3) Patient's sputum contains blood
 (4) It is caused by *Diplococcus tuberculosus*
23. Vaccine is not available against
 (1) Polio (2) Malaria
 (3) Diphtheria (4) Tuberculosis
24. Which of following disease is transmitted by animal bite and saliva?
 (1) Rabies (2) Tuberculosis
 (3) Tetanus (4) AIDS
25. The disease which begins abruptly and lasts only for a short duration is known as
 (1) Chronic disease (2) Acute disease
 (3) Congenital disease (4) Tumor
26. Tuberculosis can be prevented through vaccination with
 (1) MMR (2) TAB
 (3) ELISA (4) BCG
27. Consider the following pairs.
 A. Tuberculosis – BCG immunization and DOTS strategy
 B. Typhoid – Acute infection of the intestine
 C. Poliovirus – Destroy the cells of spinal cord
 D. Rabies – 14 injections in the stomach
 Prevention by Pasteur vaccine or by human diploid cell vaccine in the thigh or hands.
 The correctly paired groups are given in
 (1) B and D (2) A, B and D
 (3) A, B, C and D (4) B, C and D
28. Choose the wrong statement.
 (1) High blood pressure is caused by over weight and lack of exercise.
 (2) Peptic ulcers are caused by consumption of acidic food.
 (3) Acne is caused by *Staphylococci*.
 (4) Certain cancers are due to genetic abnormalities.
29. Droplet method of transmission of disease is seen in
 (1) AIDS (2) Syphilis
 (3) Hepatitis (4) Common cold
30. A protozoan disease is
 (1) Sleeping sickness (2) Kala-azar
 (3) Malaria (4) All 1, 2 and 3
31. Virus which causes hepatitis is transmitted through
 (1) Air (2) Water
 (3) Food (4) Personal contact
32. Pneumonia is an example of _____ disease.
 (1) Bacterial (2) Viral
 (3) Helminthic (4) Protozoa
33. Statements
 A. Polio vaccine is administered orally
 B. Most of the vaccines are taken intravenously
 C. Common cold is communicable and most easily infectious disease caused by viruses.

D. Vomiting acute diarrhoea and muscular cramps are the symptoms of cholera.

The correct statements are

- (1) A, B and D (2) A, C and D
(3) A, B, C and D (4) B, C and D

34. Find out the incorrect pair.

- (1) Meningitis – Brain
(2) Pneumonia – Lungs
(3) Hepatitis – Liver
(4) Fungal disease – Kidneys

35. Consider the following.

1. *Aedes albopictus* spreads Chikun guniya.
2. H_1N_1 virus causes Swine flu, whereas H_5N_1 virus causes Avian flue disease.
3. Anopheles mosquito spreads the disease filariasis.
4. Mosquitoes are common parasites in human and causing various diseases.

The totally incorrect statements are grouped in

- (1) 1, 3 and 4 (2) 2, 3 and 4
(3) 1 and 3 (4) 1 and 4

36. Which of the following disease is not caused by bacteria?

- (1) Typhoid (2) Anthrax
(3) Malaria (4) Tuberculosis

37. Which is a chronic disease?

- (1) Cold (2) Asthma
(3) Diabetes (4) Both 2 and 3

38. Children are vaccinated in the Polio Eradication Programme because

- (1) Vaccination kills the polio causing micro-organisms.
(2) It prevents the entry of polio causing organisms.
(3) It develops immunity in the body.
(4) All 1, 2 and 3

39. Diseases that are transmitted through insects vectors are

- (1) Leprosy, Plague, Elephantiasis.
(2) Malaria, Filariasis, Gambia Fever
(3) Plague, Measles, Mumps
(4) Malaria, Cholera, Typhoid

40. Polio, Diphtheria and Tetanus have been controlled to a great extent by

- (1) Spraying of insecticides in ditches, drainage and swamps.
(2) Avoiding stagnant water in an around residential areas.
(3) Introducing insectivorous fishes like *Gambusia* in ponds.
(4) Vaccines and immunization programmes.

ANSWER KEYS

PRACTICE EXERCISE 9 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 3 | 3. 2 | 4. 3 | 5. 1 | 6. 1 | 7. 4 | 8. 4 | 9. 2 | 10. 3 |
| 11. 1 | 12. 3 | 13. 2 | 14. 3 | 15. 2 | 16. 4 | 17. 2 | 18. 4 | 19. 3 | 20. 3 |
| 21. 1 | 22. 4 | 23. 4 | 24. 3 | 25. 1 | 26. 4 | 27. 2 | 28. 3 | 29. 1 | 30. 4 |
| 31. 4 | 32. 3 | 33. 4 | 34. 2 | 35. 1 | 36. 4 | 37. 2 | 38. 3 | 39. 1 | 40. 3 |

PRACTICE EXERCISE 9 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 1 | 3. 1 | 4. 3 | 5. 3 | 6. 2 | 7. 4 | 8. 1 | 9. 3 | 10. 2 |
| 11. 3 | 12. 1 | 13. 4 | 14. 1 | 15. 3 | 16. 2 | 17. 1 | 18. 4 | 19. 2 | 20. 3 |
| 21. 2 | 22. 4 | 23. 2 | 24. 1 | 25. 2 | 26. 4 | 27. 3 | 28. 2 | 29. 4 | 30. 4 |
| 31. 2 | 32. 1 | 33. 3 | 34. 4 | 35. 1 | 36. 3 | 37. 4 | 38. 3 | 39. 2 | 40. 4 |

Natural Resources

SYNOPSIS

- **Natural resources** are **living** and **non-living components of nature** which are being used by humans for meeting their requirements.
- Since, these resources are obtained from earth, they are also called earth or biosphere resources.
- Depending upon their abundance, natural resources are of **inexhaustible** and **exhaustible**.
- **Inexhaustible resources** are which occur in **abundance** and these are **not get exhausted** by continued usage. E.g., air, water, solar energy, wind and tidal energy.
- **Exhaustible** are those **natural resources** with limited availability that are **likely to get exhausted** due to **indiscriminated** human use.
- Exhaustible resources are of two types: **renewable** and **non-renewable**.
- **Renewable resources** are exhaustible resources which get **replenished regularly**. E.g., forests, wildlife, soil.
- **Non-renewable resources** are not **replenished**. E.g., fossil fuels, minerals, extinct animals and plants.

Air

- Atmosphere is divisible into four layers, **troposphere, stratosphere, mesosphere** and thermosphere. Troposphere is the lower part where as thermosphere is the upper end.
- The composition of gases in the atmosphere is counter balanced by their regeneration.
- Oxygen is utilized for respiration in most organisms and combustion of fuels where as carbondioxide is the raw material for photosynthesis of plants.
- Atmosphere also plays a significant role in **climate control**. It maintains the climate by retaining the heat.
- It also acts as a temperature buffer.
- The **movement of air** is termed as **wind**. The reasons for these phenomena are two processes: Heating of air and formation of water vapours.
- Rain is the falling down of water droplets from clouds when the water vapours present in the atmosphere cool down and condense to become heavy.
- **Air pollution** is the addition of **particulate matter**, gases, and vapours into the atmosphere that have an **adverse effect** on humans, animals and plants.
- Air pollution may be natural (forest fire, dust, storm) or man made which includes burning of fossil fuels, vehicles, thermal plants, gaseous emissions from industries, mining etc.
- **Particulate air pollutants** are also called suspended particulate matter which consists of **smoke, soot, dust** etc.

- Gases that causes air pollution are **sulphur dioxide, carbon monoxide, nitrogen dioxides, hydrogen sulphide, methane and ammonia**.
- Air pollutant produces two harmful environmental products, **acid rain** and **smog**.
- **Acid rain** is caused by the presence of **excess nitrogen oxides, sulphur dioxide** and **chlorides** in the atmosphere.
- It causes **erosion of marbles** and **lime stone structures**, killing of vegetation and aquatic life.
- **Smog** is **dark brown** or **grayish smoky mist** occurring in cold weather.
- It is a **visible indicator of air pollution**. It reduces visibility and causes suffocation in humans, animals and plants.

Water

- Water is an inexhaustible natural resource which is called as the wonder liquid.
- 71% of earth is covered by **oceans** which **contain 97.5% of the total water**.
- **Land contains only 2.5% of the total water**.
- Most of the water on earth's surface is found in seas and oceans is **saline**.
- **Fresh water** is found frozen in **polar ice caps** and **glaciers**.
- The underground water and water in rivers, lakes and ponds are fresh.
- The source of water availability is **rainfall** and is not uniform over the land.
- The availability of water in the form of rainfall determines the density and richness of biome present in an area.
- About 60 to 90% of living matter is formed of water. It acts as a **reaction medium** and an **excellent solvent** for all cellular processes.
- **Water pollution** is the degradation of the quality of water either due to **addition of undesirable substances** or **removal of desirable substances** that makes it **unfit for use** by humans, animals, industries and growth of natural biota.
- Natural water pollution is due to **silt from eroded soil** and **surface heating** of large reservoirs.
- Man made water pollution is caused by human activities like direct draining of **untreated sewage, industrial effluents**, farm chemicals, hot water etc.
- Consequences of water pollution include diseases, **eutrophication**, killing of aquatic animals **algal bloom** and **red-tide** formation.

Soil

- Soil is the upper weathered minerals and humus containing part of earth's crust which supports plant life and contains numerous living organisms and their remains.
- The outermost layer of our earth is called the **crust** and the minerals found in the outer layer supply a variety of nutrients to life forms.
- Soil contains mineral matter, organic matter, air, water and variable member of microorganisms.
- Organic matter generally occurs in the semi-decayed amorphous state called **humans**.
- **Weathering** is the process of **breaking down of rock on earth's surface** into fine **particles**.
- It occurs by physical, chemical and mechanical processing.
- **Humification** is the **addition of partially decomposed organic matter** or **humus** into weathered rock particles to **forms soil**.
- The average particle composition of soil determines its type as **sandy, clayey, loamy** etc. the quality of each type of soil further depends upon the amount of humus and soil microorganisms.
- Soil pollution is the adverse alteration of soil caused by removal or addition of substances and factors which reduce its fertility and ability to support vegetation.
- **Soil pollution** is caused mainly due to the use of chemical **pesticides** and **insecticides** as well as the **accumulation of industrial effluents** and wastes.
- **Removal of top soil** by agency of wind and water is called **soil erosion** which decreases fertility, causes landslides and floods and in turn desertification.

Biogeochemical Cycles

- There occurs a constant interaction between the **biotic** and **abiotic components** of the biosphere which involves the **transfer of matter between them**.
- The **repeated circulation of biogeochemicals** between **biotic** and **abiotic components** of the **environment** is called **biogeochemical cycling**.
- The important biogeochemical cycles include **water** or **hydrological** cycle, **gaseous** cycle and **sedimentary** cycles.
- **Nitrogen, carbon** and **oxygen** cycles are **gaseous** cycles.
- **Sulphur** and **phosphate** cycles are **sedimentary** cycles.

Water Cycle

- It is the **circulation of water** between various components of biosphere especially **evaporation from the sea, falling on land and flow back into water bodies**.
- Terrestrial plants absorb water from the soil by means of their roots.
- Animals obtain part of their water requirement from food and drinking water.
- Vapourization of water occurs from its liquid water into vapour state. In plants, it occurs by transpiration and from animals as perspiration or by respiration.
- Water vapours being lighter, rise up in the air cooling of water vapours produces tiny water droplets which form clouds and fall down as rain.
- The part of rain falling on land percolates into the soil which replenishes both ground water and soil water.
- The remaining rain water flows over land surface as **run off** and forms lakes, streams and ponds.

Nitrogen Cycle

- It is the **circulation of nitrogen** in the biosphere involving **conversion of elemental nitrogen** of air **into simple molecules** that enter living beings forming complex molecules which breakdown ultimately to **release nitrogen back** into the **atmosphere**.
- Store house of nitrogen is atmosphere. It contains **78% nitrogen**. It cannot be directly utilized by plants.
- **Nitrogen fixation** is the **conversion** of atmospheric **nitrogen gas** into **biological acceptable form as ammonia**.
- **Biological nitrogen fixation** involves a number of **free living** and **symbiotic bacteria** and **blue green algae** which are capable of fixing up atmospheric nitrogen and converting it into **ammonia** and later to forms **aminoacids**.
- *Rhizobium* is a common **symbiotic bacterium** that occurs in the **nodules of leguminous roots**.
- Atmospheric nitrogen fixation occurs in the presence of sunlight and lightning which converts small amounts of nitrogen and oxygen of the air to form **nitric oxides** and it reach to the soil through rain.
- **Nitrogen assimilation** is carried out by the plants. The plants absorb nitrates or ammonium ions from their medium.
- Nitrate is first converted into ammonium compound.
- Ammonium ions combine with organic acids to form **amino acids**.

- Aminoacids give rise to proteins. Nucleotides and nucleic acids formation also require nitrogen.
- Animals obtain **organic nitrogen** directly or indirectly from plants and gets ingested and digested, finally assimilated into the animals' protoplasm.
- The dead remains of plants and animals are acted upon by decomposers.
- They hydrolyze the nitrogenous compounds to release ammonia and organic acids.
- This phenomenon is called **ammonification**.
- Ammonia undergoes **nitrification** with the help of nitrifying bacteria.
- *Nitrosomonas* oxidizes ammonia into nitrite while *Nitrobacter* oxidizes it further to nitrate. Nitrate is reabsorbed by plants for assimilation.
- **Denitrification** is the process of conversion of **nitrates** into **gaseous nitrogen** which escapes into atmosphere.
- **Denitrification** is carried by bacteria present in water logged soils E.g., *Pseudomonas*.

Carbon Cycle

- The **repeated circulation** of **carbon** in **biosphere** between the **biotic** and **abiotic components** is called **carbon cycle**.
- Carbon is formed in the atmosphere in the form of **carbon dioxide**.
- All the photosynthetic organisms absorb carbon dioxide from the air and convert it into glucose and other related organic compounds by the process of photosynthesis.
- The animals consume the plants directly or indirectly and are used for the synthesis of their own organic substances as well as their structural components.
- **Carbon sediments** down and gives rise to **carbonate rocks** like **limestone**.
- The carbonates **settle down** at the bottom of **ocean** and become **covered by sediments** to form **fossils**.
- Later these undergo changes converting them into **fossil fuels** like **coal, petroleum** and **natural gas**.
- **Carbondioxide** is **returned back** to the **atmosphere** by **respiration, combustion of fossil fuels, decomposition of dead and decayed matter** and **weathering of carbonate rocks** and minerals.
- Large scale **deforestation** and increasing **combustion of fossil fuels** results in an **imbalance in carbon cycle** and results **Green house effect** and **Global warming**.

- **Greenhouse effect** allows the solar radiations to pass in to the earth's atmosphere but prevents long wave heat radiations to pass out due to the presence of radiatively active gases called **green house gases** like **CO₂**, **methane**, **nitrous oxide**, **chlorofluorocarbons** (CFC's).
- **Raising the temperature of earth's surface and its immediate atmosphere** due to green house gases is called **global warming**.
- **Global warming** may **lead to melting of polar ice caps** and **glaciers** and results in flood and sea level rise.
- **Global warming** also results in **El Nino Effect** (odd climatic changes).

Oxygen Cycle

- The **repeated circulation of oxygen** between the different components of biosphere.
- The common storehouse of oxygen is atmosphere.
- Oxygen is the most abundant element on earth forming nearly 47% of all elements. It occurs in the atmosphere as the **second most abundant gas** forming **nearly 21% of the air**.
- **Oxygen dissolves in water** and helps in the aquatic organisms respiration.
- Oxygen is essential for respiration of most organisms. It is required in combustion.
- The source of **replenishment of oxygen** is **photosynthesis**.

- **Ozone** is triatomic oxygen (O₃). The ozone layer occurs in the **stratosphere** of the atmosphere and forms **ozonosphere** or **ozone shield**.
- It is highly important as it **filters out** very harmful high energy **ultraviolet radiations** coming from sun.
- **Ozone layer** is getting **depleted due** to various man made compounds like **CFC** which contains both active **chlorine** and **fluorine** which act with ozone molecules results in the **damage of ozone layer**.

Phosphorus Cycle

- The **repeated cycling** of phosphorous between the **living organisms** and **surroundings** is known as **phosphorus cycle**.
- Phosphorus is directly absorbed by the plants and the animals derive it from plant products.
- The **natural reservoir of phosphorus** is **phosphate rock**.
- **Weathering of phosphate rock** and decomposing organisms like **phosphate-solubilizing bacteria** **release the phosphorus** into the surroundings.
- **Phosphorus** is **essential** for animals to make **shells, bones** and **teeth**.
- It also becomes the integral part of **nucleic acids, cell membranes** and for **energy storage** and **releasing molecules, ATP**.

PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Select the non-renewable natural resource from the following.
 (1) Forests (2) Soil
 (3) Water (4) Fossil fuels
2. Which among the following in excess quantity indicates the contamination of Ganga water bodies?
 (1) Dissolved minerals (2) Coliform bacteria
 (3) Dissolved carbon (4) Dissolved phosphates
3. The sources of acidic rain is atmospheric
 (1) Sulphur oxides (2) Nitrogen oxides
 (3) Carbon monoxide (4) Both 1 and 2
4. Out of total water content, sea constitutes
 (1) 97.5% (2) 71%
 (3) 81% (4) 91.2 %
5. Nearly 76% of fresh water is confined in
 (1) Ice caps and glaciers
 (2) Soil water
 (3) Ground water
 (4) Surface water
6. What would happen if all the oxygen present in the environment is converted into ozone?
 (1) We will have greater protection from UV rays of sun
 (2) It will become poisonous and kill living forms.
 (3) Ozone is not stable so that it will be converted back into oxygen.
 (4) Harmful radiations from the sun will reach the earth and damage many life forms.
7. Which of the following are the strategies to be taken for saving the environment?
 A. Reduce the use of electricity, water, food and fuels.
 B. Recycle the products like plastic, glass, paper and metals.
 C. Reuse instead of throwing the envelopes, plastic bags and bottles etc.
 D. Using public transport system and resources only.
 The correct ones are given in
 (1) A, B and C (2) A, C and D
 (3) A, B and D (4) B, C and D

8. Gaseous envelop surrounding the earth is called
 (1) Lithosphere (2) Mesosphere
 (3) Stratosphere (4) Atmosphere
9. Ozone layer of the atmosphere
 (1) Absorbs UV rays and X-rays
 (2) Absorbs cosmic and gamma rays.
 (3) A good absorber of UV rays
 (4) A bad absorber of X-rays
10. The study of the timing of seasonal activities of plants in relation to environmental changes is called
 (1) Physiology (2) Phenology
 (3) Etiology (4) Ecology
11. Biological weathering of rock is caused by
 (1) Lichens (2) Mosses
 (3) Roots of plants (4) All 1, 2 and 3
12. Evidence of eutrophication of water indicates.
 (1) Reduced oxygen demand
 (2) Rapid decomposition of organic matter.
 (3) Algal bloom
 (4) Red tide
13. The upper most weathered layer of earth's crust is
 (1) Sand (2) Organic matter
 (3) Soil (4) Minerals
14. The washing away or removal of soil from land is called
 (1) Soil formation (2) Soil erosion
 (3) Crop rotation (4) Recycling
15. The most important factor supporting living organisms is
 (1) Rainfall (2) Humidity
 (3) Temperature (4) Water
16. Statements:
 A. Water shed management helps in scientific soil and water conservation.
 B. Water harvesting techniques are locally specific and locally benefited.
 C. Check dams are practiced for the conservation of seasonally flooded gullies.
 D. Ground water storage technique is more effective than open air storage of water.

The totally correct statements are

- (1) A, B, C and D (2) A, C and D
(3) B, C and D (4) A, B and D

17. The part of the earth supporting life is

- (1) Biome (2) Niche
(3) Biosphere (4) Land

18. Amazon rain forests are called

- (1) Heart of the planet (2) Lungs of the planet
(3) Liver of the planet (4) Kidney of the planet

19. 21st March is celebrated as

- (1) World environment day
(2) No tobacco day
(3) World population day
(4) World forestry day

20. Forests are responsible for

- (1) Ecological balance
(2) Prevention of soil erosion and flood
(3) Pollution free environment
(4) All 1, 2 and 3

21. Nitrification means

- (1) Conversion of nitrates into ammonia
(2) Conversion of ammonia into nitrates.
(3) Conversion of nitrogen into salts of nitrogen
(4) Conversion of nitrogen salts into free nitrogen.

22. Overall contribution of carbon dioxide to global warming is

- (1) 20% (2) 14%
(3) 6% (4) 60%

23. Denitrification is caused by

- (1) *Pseudomonas* (2) *Nitrobacter*
(3) *Nitrosomonas* (4) *Azotobacter*

24. The factor responsible for depletion of ozone layer is

- (1) Excessive use of automobiles.
(2) Excessive industrial units.
(3) Excessive use of man-made compounds containing chlorine and fluorine.
(4) Excessive deforestation.

25. If there is no atmosphere around the earth, the temperature of the earth will

- (1) Increase continuously
(2) Go on decreasing
(3) Increases during day and decreases during night.
(4) Remains unaffected.

26. Rain fall patterns depend on

- (1) The underground water table.
(2) The number of water bodies in an area.
(3) The density of human population in an area.
(4) The prevailing season in an area.

27. Which among the following is/are the problem(s) of environment?

- (1) Ozone layer depletion
(2) Green house effect
(3) Global warming
(4) All 1, 2 and 3

28. The major source of minerals in the soil is

- (1) Parent rock from which soil is formed
(2) Plants
(3) Animals
(4) Decomposers

29. Oxygen is returned to the atmosphere mainly by

- (1) Burning of fossil fuels
(2) Respiration
(3) Metabolism
(4) Photosynthesis

30. An increase in carbon dioxide content in the atmosphere would not cause

- (1) More heat to be retained by the environment.
(2) Increase in photosynthetic rate in plants.
(3) Global warming
(4) Ozone layer depletion

31. The process which is adversely affected by the presence of oxygen is

- (1) Nitrogen fixation
(2) Photosynthesis
(3) Respiration
(4) Transpiration

32. Ozone hole means

- (1) A large sized hole in the stratosphere layer.
(2) Thinning of the ozone layer at the poles.
(3) Small holes scattered in the ozone layer.
(4) Thickening of the ozone layer at the poles.

33. The two forms of oxygen formed in the atmosphere are

- (1) Water and ozone
(2) Ozone and oxygen
(3) Water and oxygen
(4) Water and carbondioxide

34. A non-eco friendly source of energy is
 (1) Tidal energy (2) Wind energy
 (3) Solar energy (4) Nuclear power
35. Ozone day is observed on
 (1) 16 September (2) 5 June
 (3) 21 April (4) 25 December
36. Desertification is brought about by
 (1) Deforestation
 (2) Crop Rotation
 (3) Inter cropping
 (4) Sand particles
37. Solar energy is a
 (1) Non-conventional energy source
 (2) Exhaustible resources
- (3) Pollution free energy source
 (4) All 1, 2 and 3
38. Forest resources are maximum in
 (1) Africa (2) India
 (3) America (4) Australia
39. Minamata disease is caused by the pollution of water by
 (1) Cadmium (2) Mercury
 (3) Lead (4) Arsenic
40. Run off components of fertilizer rich fields causes
 (1) Turbidity of water bodies
 (2) Eutrophication of water bodies
 (3) Precipitation of toxic chemical
 (4) Temperature variations in water

PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

- Which one of the following is an inexhaustible resource?
 (1) Soil (2) Fossil fuels
 (3) Minerals (4) Solar radiation
- In which part of the atmosphere is the cloud formation restricted?
 (1) Troposphere
 (2) Stratosphere
 (3) Ozonesphere
 (4) Thermosphere
- Consider the statements:
 A. Fossil fuels, coal and petroleum will ultimately get exhausted.
 B. Resources like forest, wild life, water, coal and petroleum are not to be used in a sustainable manner.
 C. The main source of air pollutant particulate matter is mining areas.
 D. DDT, mercury, lead, arsenic, plastics and radioactive wastes are non-biodegradable pollutants.
 The correct statements are
 (1) B, C and D (2) A, C and D
 (3) A, B and D (4) A, B, C and D
- Ozone layer of the atmosphere lies in the
 (1) Stratosphere (2) Ionosphere
 (3) Troposphere (4) Exosphere
- The environment is composed of
 (1) Lithosphere, hydrosphere, atmosphere
 (2) Lithosphere and stratosphere
 (3) Troposphere and stratosphere
 (4) Lithosphere and Hydrosphere
- Atmospheric nitrogen fixation occurs with the help of energy from
 (1) Heat and pressure
 (2) Lightning, electric stream and UV radiations.
 (3) Ozone
 (4) Sulphur trioxide
- High diversity of living organisms is observed in
 (1) Deserts
 (2) Tropical forests
 (3) Temperate forests
 (4) Grasslands
- Wild life is affected to maximum when
 (1) Protection and care is less
 (2) Hunting and poaching is carried out
 (3) Natural calamities
 (4) Natural habitat is destroyed

9. Cadmium pollution of water body produces a disease in humans called
 - (1) Black foot disease
 - (2) Minamata disease
 - (3) Itai-itai
 - (4) Methaemoglobinemia
10. Carbon dioxide is withdrawn from carbon cycle in the forms of
 - (1) Organic matter
 - (2) Carbonate rocks
 - (3) Carbonate shells and skeletons in animals
 - (4) Both (2) and (3)
11. Soil erosion can be prevented by
 - (1) Raising forests
 - (2) Photosynthesis
 - (3) Deforestation
 - (4) Overgrazing by animals
12. Which of the following acids fall on land with rain during lightening?
 - (1) Nitric and nitrous acids
 - (2) Hydrochloric and sulphuric acids
 - (3) Sulphuric and nitrous acids
 - (4) Hydrochloric and nitrous acids
13. One of the following processes is not a step involved in water cycle operating in nature:
 - (1) Photosynthesis
 - (2) Evaporation
 - (3) Rain fall
 - (4) Nitrogen metabolism
14. Choose the incorrectly paired one.

(1) Kaziranga National Park	– One horned Rhinoceros
(2) Nandankanan Biological Park	– Captive breeding of white tigers
(3) Dachigam sanctuary	– Kashmir stag
(4) Rann of Kutch	– Shola forest
15. The symbiotic nitrogen fixing bacterium in root modules of legumes.
 - (1) *Pseudomonas*
 - (2) *Bacillus*
 - (3) *Rhizobium*
 - (4) *Nitrobacter*
16. The percentage of nitrogen in the atmosphere is

(1) 86%	(2) 78%
(3) 20%	(4) 50%
17. A man made sources of air pollution is
 - (1) Burning of fossil fuels
 - (2) Dust storm
 - (3) Pollen grains
 - (4) Forest fire
18. Chlorofluorocarbons are generally used in
 - (1) Aerosol
 - (2) Formation of foam
 - (3) Refrigerators
 - (4) All 1, 2 and 3
19. The bacterium *Nitrosomonas* changes
 - (1) Ammonia into nitrate
 - (2) Ammonia into nitrite
 - (3) Nitrite into nitrate
 - (4) Nitrate into ammonia
20. Percentage of total water found as fresh water is

(1) 46%	(2) 32%
(3) 16%	(4) 2.5%
21. Dissolved gas present in acid rain is
 - (1) Hydrogen chloride
 - (2) Nitrogen oxides
 - (3) Sulphur dioxide
 - (4) All 1, 2 and 3
22. The process of nitrogen fixation by root nodule bacteria does not take place in the presence of
 - (1) Molecular form of hydrogen
 - (2) Elemental form of oxygen
 - (3) Water
 - (4) Elemental form of nitrogen
23. Among the following, the wrongly matched statement regarding the use of chemical fertilizers and pesticides is
 - (1) They are eco-friendly
 - (2) The field turn barren after some time
 - (3) Adversely affect the useful component from the soil.
 - (4) They destroy soil fertility
24. Which step is not involved in carbon cycle?
 - (1) Photosynthesis
 - (2) Respiration
 - (3) Transpiration
 - (4) Combustion of fossil fuels

25. The nitrogen present in air can be converted into nitrates by
- (1) A biological process of nitrogen fixing bacteria present in the soil and root nodules.
 - (2) Photosynthesis
 - (3) Chemosynthesis
 - (4) All 1, 2 and 3
26. Which of the following is not a green house gas?
- (1) Methane
 - (2) Carbon dioxide
 - (3) Carbon monoxide
 - (4) Ammonia
27. Select the correct statement regarding water pollution:
- (1) A change in the temperature of water bodies.
 - (2) A change in the pressure of water bodies.
 - (3) The removal of desirable substances from water bodies.
 - (4) Addition of undesirable substances to water bodies.
28. What happens when rain falls on soil without vegetational cover?
- (1) Rain water percolates into soil efficiently
 - (2) Rain water causes loss of surface soil.
 - (3) Rain water leads to fertility of the soil
 - (4) Does not cause any changes in the soil
29. The top soil contains
- (1) Humus, living organisms and soil
 - (2) Humus, living organisms and plants
 - (3) Humus and soil particles
 - (4) Humus and microorganisms
30. Domestic waste is
- (1) Effluents and non-degradable
 - (2) Non-biodegradable substances
 - (3) Biodegradable substances
 - (4) Air pollutants only
31. Most abundant water pollutant is
- (1) Detergents
 - (2) Pesticides
 - (3) Industrial wastes
 - (4) Ammonia
32. Spraying of DDT produces pollution of
- (1) Air
 - (2) Air and water
 - (3) Air and soil
 - (4) Air, water and soil
33. Air pollution is maximum due to
- (1) Sewage and pesticides
 - (2) Automobile exhausts and industrial wastes.
 - (3) Sewage and effluents
 - (4) Detergents and pesticides
34. Gas released during Bhopal tragedy was
- (1) Methyl isocyanate
 - (2) Potassium isothiocyanate
 - (3) Sodium isothiocyanate
 - (4) Ethyl isothiocyanate
35. UV light radiations cause
- (1) Formation of pyrimidines
 - (2) Photodynamic action
 - (3) Breakage of hydrogen bonds in DNA
 - (4) Protein denaturation
36. A pollutant that causes irritation in eyes, nose and throat.
- (1) CO
 - (2) SO₂
 - (3) CFC
 - (4) CH₄
37. Corrosion of statues and monuments occurs due to
- (1) Photochemical smog
 - (2) Carbon monoxide
 - (3) Acid rain
 - (4) Methane
38. A colourless, non-irritant, lightly toxic gas that impairs respiration is
- (1) Sulphurdioxide
 - (2) Nitrous oxide
 - (3) Carbondioxide
 - (4) Carbon monoxide
39. Photochemical smog is formed by
- (1) Nitrogen oxides
 - (2) Hydrocarbons
 - (3) Nitrogen oxides and hydrocarbons
 - (4) Solar radiations upon nitrogen oxides and hydrocarbons.
40. Maximum air pollution is seen in which metropolitan city in India?
- (1) Delhi
 - (2) Bhopal
 - (3) Kolkata
 - (4) Bangalore

ANSWER KEYS

PRACTICE EXERCISE 10 (A)

1. 4	2. 2	3. 4	4. 1	5. 3	6. 2	7. 1	8. 4	9. 3	10. 2
11. 4	12. 3	13. 3	14. 2	15. 4	16. 1	17. 3	18. 2	19. 4	20. 4
21. 2	22. 4	23. 1	24. 3	25. 3	26. 2	27. 4	28. 1	29. 4	30. 4
31. 1	32. 2	33. 2	34. 4	35. 1	36. 1	37. 4	38. 3	39. 2	40. 2

PRACTICE EXERCISE 10 (B)

1. 4	2. 1	3. 4	4. 3	5. 1	6. 2	7. 2	8. 4	9. 3	10. 4
11. 1	12. 3	13. 4	14. 4	15. 3	16. 2	17. 1	18. 4	19. 2	20. 4
21. 4	22. 2	23. 1	24. 3	25. 1	26. 4	27. 4	28. 2	29. 1	30. 3
31. 3	32. 4	33. 2	34. 1	35. 3	36. 2	37. 3	38. 4	39. 4	40. 3

Crop Improvement

SYNOPSIS

- The growing of certain plants of the same kind at a place is called **domestication** of plants or **agriculture**.
- The specialised field for **rearing** of animals is animal **husbandry**.
- The strategies adapted in increasing the crop output is **Green revolution**, for increased fish production is the **Blue revolution**, for increased oil production is **Yellow revolution** and for increased milk production is **White revolution**.
- The branch of agriculture concerned with rearing and management of **crop plants** and its **environment** is called **Agronomy**.
- The science of growing and management of fruits and flowering plants in orchards and gardens is called **Horticulture**.
- Growing and management of vegetable is known as **Olericulture**.
- Crops are categorized into **Kharif** and **Rabi** based on the seasons.
- **Kharif crops** are **monsoon crops** grown in June, October. E.g., Paddy and maize.
- **Rabi crops** are **winter crops** grown in November, April. E.g., Wheat, legumes, Jowar.
- Crop cultivation involves several activities referred to as **agricultural practices**.
- Crops are plants cultivated by humans for **food, fodder** and for other products.
- The important type of crops are: **cereal** crops (wheat, rice, maize, barley, sorghum, millets), **pulses** (grams, peas, and beans), **oil seeds** (groundnut, mustard, soybean, castor), **spices** (chilly, pepper, cardamom, ginger, turmeric), **fruits** and **vegetables**.
- **Fodder crops** include berseem, oats, and grasses which provide food for domesticating animal stock.

Crops Variety Improvement

- The objectives of crop improvement are **higher yield, improved quality, resistance** to **biotic** and **abiotic stresses**, **desired agronomic traits**, **wider adaptability** and **easy acclimatization**.
- **Plant breeding** is the **science and art of improving** the **heredity of plants** in relation to their **economic use**.
- **Crop production management** means controlling various aspects of crop production so as to obtain maximum and the best yield with no or low cost.
- It has three aspects **nutrient management, irrigation** and **cropping pattern**.
- **Nutrient management** is controlling the selection, timing and **amount of nutrient supply** to the crops.
- Nutrients are supplied to plants by **air, water** and **soil**.

- There are **16 nutrients** which are **essential** for plants. Carbon and oxygen, derived from air, hydrogen comes from water and soil supplies the other 13 nutrients to plants.
- Amongst these 13 nutrients, six are required in large quantities and are called **macronutrients**.
- The other seven nutrients are used by plants in small quantities are called **micronutrients**.
- **Macronutrients** include **nitrogen, phosphorus, potassium, calcium, magnesium and sulphur**.
- The **micronutrients** are **iron, boron, manganese, zinc, copper, molybdenum and chlorine**.
- **Manure** contains large quantities of organic matter and also supplies small quantities of nutrients to the soil.
- Manure is prepared by the decomposition of animals excreta and plant wastes.
- **Manure** helps in **enriching soil** with **nutrients** and **organic matter** and increasing **soil fertility**.
- Based on the kind of biological waste materials used, manure can be classified as: **compost, vermicompost and green manure**.
- The process in which the **farm waste materials** like livestock excreta, vegetable wastes, **animal refuses, domestic wastes, sewage wastes, straw** etc are **decomposed in pits** is known as **composting**.
- The **compost** is **rich** in **organic matter** and **nutrients**.
- **Compost** prepared by using **earthworms** to hasten **decomposition** of **plant** and **animal remains** is called **vermicompost**.
- **Green plants** like **sun-hemp** or grasses are grown and then **mulched by ploughing** them **into the soil** makes **green manure** which **enriches** the **soil** in **nitrogen** and **phosphorus**.
- **Fertilizers** are **commercially produced** plant nutrients which supply **nitrogen, phosphorus and potassium**.
- **Irrigation** is the supply of water to agricultural lands depending on water source available like wells, canals, tanks, river lift systems etc.
- Cropping pattern can be adopted in different ways to gain maximum benefit.
- **Mixed cropping** is done and is the technique of **growing two or more different crops** together in the **same field** and this gives assurance against crop failure of one of the crops.
- **Inter-cropping** is **growing two or more crops simultaneously** on the **same field** in a definite pattern to give **better returns**.
- **Crop rotation** is the growing of different crops on a piece of land in a pre-planned succession to obtain good harvests and increasing soil fertility.
- **Legumes** are **grown one among the plant** in **crop rotation**.
- **Weeding** is another important step to be followed for improving the yield.
- All plants other than crop plants seen in a field are known as **Weeds**.
- **Weeding** means the **removal of weeds** from the crop fields.
- Weeding can be practiced by **manually**, or by means of **weedicides or herbicides**.
- Weeding is practiced by **manual uprooting** or **cutting the weeds** close to the ground; **chemical weedicides** are generally sprayed to the cultivating fields directly.
- **Chemical herbicides** of plant source are now days used for weeding, which are found to be better than the weedicides.
- **Crops** to be **protected** from **stray animals** and **pests**.
- **Mud walls** and **wire fences** help to **prevent** the intrusion of **stray animals**.
- Chemical **pesticides** are to be used for controlling various pests like **locusts, stem borer, boll worm, sap sucking aphids** etc.
- **Pesticides** are used as **spray** to control these **pest's eggs and larvae**.

Improved Varieties of Crops

- Green revolution started in India in 1960's under the guide lines of **Dr M.S. Swaminathan**.
- **Dr M.S. Swaminathan** is known as the "**Father of Indian Green Revolution**" and **Norman Ernst Borlaug** is known as the "**Father of Green Revolution**," Internationally.
- *Sanalika, Kalyan sona, Sonora-64* etc., are the high yielding improved varieties of wheat.
- *IR-8* and *Taichung Native-1* are the internationally improved varieties of paddy plants.
- *Jaya, Ratna, Padma* and *Pusa-215* etc., are the improved Indian varieties of paddy.
- *Genga 101* and *Ranjit* are improved varieties of maize.
- Nowadays, **biofortified crops** are developed in India to overcome malnutrition.
- **Biofortified crops** have **high content** and **quality** of **proteins, oils, vitamins, minerals and micronutrients**.

- *Atlas-66* is a **high protein content** showing **wheat** developed in India.
- *Shakti*, *Ratan* and *Protina* are the varieties of **maize**, developed in India and all these have twice the amount of **amino acids lysine** and **tryptophan**.
- **Iron-fortified rice** variety; vitamins and minerals enriched vegetables like carrot, spinach, tomato, pumpkin; iron and calcium enriched bathua (pumpkin) and spinach and protein enriched beans, lablab, French and garden peas etc., are also developed in India.
- **Indian Agricultural Research Institute (IARI)**, New Delhi, released all these biofortified varieties.

Animal Husbandry

- The branch of agriculture which deals with the feeding, shelter, health and breeding of domestic animals is called **animal husbandry**.
- It is the **scientific management of live-stock animals**.
- Cattle husbandry is done for two purposes, **milk** and **draught labour** for agricultural works like tilling, irrigation, carting etc.
- **Milk producing females** are called **dairy** or **milch animals** while **males** engaged in farm labour are called **draught animals**.
- Milk production can be **increased** by lactation period.
- Exotic or foreign breeds (**Jersey**, **Brown Swiss**) are selected for long lactation periods.
- Local breeds (**Red Sindhi**, **Sindhi**, **Sahiwal**) show excellent **disease resistance**. The two can be cross bred to get animals with both the desired qualities.
- Proper cleaning, shelter facilities, feed and water, prevention and cure of animal diseases are important practices for cattle farming.
- **Poultry** farming is undertaken to raise domestic fowls for **egg** production and **meat**.
- The cross breeding programmes between Indian indigenous variety **Aseel** and foreign exotic variety **Leghorn** results new fowl varieties with quality, quantity and adaptations.
- **Fish production** involves the rearing of **finned true fishes** as well as **shell fishes** such as **prawns**, **crabs** and **molluscs** and all these come under **Pisciculture**.
- There are two ways of obtaining fish. One is from the natural resource, which is called **captured fishing**. The other way is by **fish farming** which is called **culture fishery**.
- The culture of finned fishes is called **Pisciculture** and that of all fishes including shelled fishes is called **Aquaculture**.
- To increase the production of fish, these can be cultured in marine and inland (fresh water) ecosystems.
- Popular **marine fish** varieties are **Pomphret**, **Mackerel**, **Tuna**, **Sardines** and **Bombay duck**.
- The shelled fishes such as **prawns**, **mussels** and **oysters** have great economic values.
- **Oysters** are also cultivated for obtaining **pearls** for jewelry.
- The **culture of marine fishes** in a large scale is called **Mariculture**.
- Fresh water resources include canals, ponds, reservoirs and rivers.
- Brackish water resources are the **sea water** and **fresh water mixing** areas.
- **Estuaries** and **Lagoons** are important fish reservoirs.
- The popular edible **fresh water fishes** are *Catla*, *Silver Carp*, *Rohu*, *Mrigal*, *Common Carp* etc.
- **Beekeeping (Apiculture)** is rearing, and management of **honey bees** for obtaining **honey**, **wax** and other substances.
- Honey is a syrup which is rich in sugar, minerals, vitamins, enzymes and has lot of medicinal values.
- **Beehives** are the source of **wax** which is used widely in creams, cosmetics and ointments.
- The three common varieties of bees cultured are *Apis indica* (Indian bee), *Apis dorsata* (rock bee) and *Apis florae* (little bee).
- An **Italian bee** variety, *Apis mellifera*, is also commonly used for commercial honey production due to its **higher yield**.

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Increase in edible oil production is called
 - (1) Golden Revolution (2) Yellow Revolution
 - (3) White Revolution (4) Blue Revolution
2. Branch of science that is concerned with culturing of vegetables.
 - (1) Floriculture (2) Horticulture
 - (3) Agriculture (4) Olericulture
3. Which one of the following is Kharif crops?
 - (1) Paddy and maize
 - (2) Wheat and legumes
 - (3) Pulses and maize
 - (4) Maize and wheat
4. The science of developing high yielding varieties of crop is
 - (1) Emasculation (2) Selection
 - (3) Introduction (4) Plant breeding
5. When both crops and live-stocks are raised on the same farm it is known as
 - (1) Mixed farming (2) Mixed cropping
 - (3) Inter cropping (4) Crop rotation
6. Rotation of crops helps in
 - (1) Insects control
 - (2) Altering chemical nature of soil
 - (3) Improving soil fertility and yield
 - (4) Proliferating weeds
7. The organism which is involved in vermi-compost making.
 - (1) Earth worm (2) Leech
 - (3) Snail (4) Beetle
8. The process of cross breeding of two different varieties of crops each having a desired characteristic is known as
 - (1) Selection (2) Crossing
 - (3) Hybridization (4) Introduction
9. The principal cereal crop of India is
 - (1) Wheat (2) Rice
 - (3) Maize (4) Sorghum
10. Poultry birds reared for obtaining meat are
 - (1) Layers (2) Draught
 - (3) Growers (4) Broilers
11. Which one of the following yields maximum milk per year?
 - (1) Holstein-Friesian (2) Brown-swiss
 - (3) Sahiwal (4) Red sindhi
12. Which one of the following is not a draught animals?
 - (1) Camel (2) Elephant
 - (3) Goat (4) Horse
13. Father of Green Revolution at Inter National Level
 - (1) Norman E. Borlaug
 - (2) M.S. Swaminathan
 - (3) Haberlandt
 - (4) Gregor Johan Mendel
14. Branch of agriculture concerned with rearing, breeding and economic exploitation of livestock is
 - (1) Cattle farming (2) Animal husbandry
 - (3) Animal breeding (4) Grooming
15. The crop that requires a constant supply of water.
 - (1) Wheat (2) Bajra
 - (3) Paddy (4) Jowar
16. The revolution that resulted in an increase in agricultural output in India is
 - (1) White revolution
 - (2) Silver revolution
 - (3) Blue revolution
 - (4) Green revolution
17. Identify the essential element that is seen as the constituent of chlorophyll.
 - (1) Manganese (2) Magnesium
 - (3) Potassium (4) Nitrogen
18. The culturing of more than one variety of fish in a pond is called
 - (1) Poly culture (2) Composite culture
 - (3) Both (1) and (2) (4) Pisciculture
19. The use of a natural predation against another pathogenic organism is called
 - (1) Genetic control (2) Biological control
 - (3) Artificial control (4) Pesticidal control

20. White Revolution is associated with the increase in the production of
 (1) Milk (2) Wool
 (3) Egg (4) Meat
21. The milk producing female live stock animals are called
 (1) Dairy animals (2) Milch animals
 (3) Draught animals (4) Both (1) and (2)
22. The commercial rearing of honey bee is known as
 (1) Vermiculture (2) Apiculture
 (3) Pisciculture (4) Aquaculture
23. An exotic breed of cattle is
 (1) Ongole (2) Snidhi
 (3) Jersey (4) Sahiwal
24. Which of the following is an Italian bee variety?
 (1) *Apis indica* (2) *Apis mellifera*
 (3) *Apis dorsata* (4) *Apis florea*
25. Poultry farming is practiced for
 (1) Egg production only
 (2) Egg and feather production
 (3) Egg and feather production
 (4) Egg and meat
26. Which of the following is not a cropping pattern useful in increasing food production?
 (1) Mixed cropping (2) Continuous selection
 (3) Inter cropping (4) Crop rotation
27. Milk production in cattle depends on
 A. Lactation period
 B. Food type
 C. Location and milking time
 D. Breed
 The correct option is
 (1) A, B and C (2) A, C and D
 (3) A, B and D (4) B, C and D
28. The most popular exotic breed of poultry is
 (1) *Plymoth* (2) *Rhole Island Red*
 (3) *Minorca* (4) *White Leghorn*
29. Which of the following contains macro nutrients only?
 (1) Calcium, sulphur and zinc
 (2) Nitrogen, potassium and phosphorus
 (3) Ca, Mg and Cu
 (4) Nitrogen, Iron and chlorine
30. Select the mismatched pair from the following.
 (1) Marine fish – Carp
 (2) Local breed – Aseel
 (3) Exotic breed – Jersey
 (4) Biofertilizer – *Azolla*
31. Which of the following is/are natural insecticide(s)?
 (1) Nicotine (2) Neem
 (3) Pyrethrum (4) All 1, 2 and 3
32. Which one is an oil yielding plant among the following?
 (1) Lentil (2) Sunflower
 (3) Hibiscus (4) Pea
33. Cattle husbandry is done for the following purposes.
 A. Milk production
 B. Agricultural work
 C. Meat production
 D. Hides production
 The correct one among the following is
 (1) B, C and D (2) A, B and D
 (3) A, B, C and D (4) A, C and D
34. Weeds affect the crop plants by
 (1) Killing of plants in field before they grow.
 (2) Dominating the plants to grow
 (3) Competing for various resources of crops causing low availability of nutrients.
 (4) All 1, 2 and 3
35. Which of the following is known as little bee?
 (1) *Apis indica* (2) *Apis florae*
 (3) *Apis dorsata* (4) *Apis mellifera*
36. Select the marine organisms from the following.
 (1) Oysters and mussel (2) Rohu and Carp
 (3) Prawn and Mrigal (4) Prawn and Carp
37. Consider the statements.
 A. Nutritionally enriched crops having minerals, vitamins and micronutrients are known as hybrids.
 B. Dragon flies and Ladybirds are used to get rid of aphids.
 C. Insect pests like cotton boll worms can be controlled by introducing the bacterium *Bacillus thuringiensis*.
 D. Several root infecting plant pathogens can be controlled by *Trichoderma* fungus.

The correct statements are

- (1) A, B and D (2) A, C and D
(3) B, C and D (4) A and D

38. Which of the following is wrong for green manure?

- (1) It supplies organic matter
(2) It supplies nitrogen
(3) It prevents soil erosion
(4) It allows leaching

39. The device used for measuring the quality of milk is

- (1) Respirometer (2) Sphygmomanometer
(3) Lactometer (4) Anemometer

40. Rabi crops are grown during

- (1) June – October
(2) October – March
(3) November – April
(4) September – March

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Hybridization is the process that is done

- (1) To obtain new breeds by self fertilization
(2) To obtain new varieties with desirable characters by cross fertilization.
(3) To obtain new varieties which show low sensitivity towards disease.
(4) To obtain hybrids which have a low yield by crossing.

2. The common weedicide used in cultivating fields is

- (1) 2, 4-D (2) 2, 4, 5-T
(3) IAA (4) ABA

3. The strategy followed for increasing egg production is

- (1) White Revolution (2) Green Revolution
(3) Silver Revolution (4) Blue Revolution

4. The removal of topsoil by water and wind is called

- (1) Soil tilling (2) Soil erosion
(3) Soil mulching (4) Weathering

5. Vermiculture is the large scale multiplication of

- (1) Silk worm (2) Honeybee
(3) Earth worm (4) Mulberry

6. Nature's ploughman is

- (1) Earth worm (2) Farmer's plough
(3) Round worm (4) Silk worm

7. The world's largest dairy development programme designed and implemented in India is called

- (1) Milk revolution (2) White Revolution
(3) Operation flood (4) Silver revolution

8. Find out the wrong statement from the following.

- (1) White Revolution means strategy adapted for increase in milk production.
(2) Blue Revolution is meant for increase in fish production.
(3) Increasing food production without compromising with equality in both yield and environment is called sustainable development.
(4) Harmful insect's management is known as integrated pest management programme (IPM).

9. Poultry fowls are susceptible to the pathogens like

- (1) Bacteria (2) Virus
(3) Fungi (4) All 1, 2 and 3

10. Best sources of dietary protein for a vegetarian is

- (1) Soybean (2) Gram
(3) Milk (4) Groundnut

11. Sheep are reared mainly for

- (1) Meat (2) Muttan
(3) Wool (4) Milk

12. Pomfret is a

- (1) Brackish water fish (2) Marine fish
(3) Fresh water fish (4) Cuttle fish

13. Fish farming accounts

- (1) Aquaculture (2) Pisciculture
(3) Capturing of fish (4) All 1, 2 and 3

14. In plant breeding/hybridization, removal of stamens in the early stage of bisexual flower is practiced and it is known as

- (1) Emasculation (2) Crossing
(3) Sterilization (4) Pure-line selection

15. Consider the following microbes:

- A. *Azotobacter*
- B. *Azolla*
- C. Mycorrhizal fungus
- D. *Nostoc*

The above given microbes belong to

- (1) Manure yielding biofertilizer category
- (2) Convert atmospheric nitrogen into ammonia
- (3) All are capable of improving the elements phosphorus, potassium, zinc etc., in soil.
- (4) All are the source of nitrogenous fertilizer.

16. Good quality fowls reared are given in

- (1) *Malabari, Murrah and Badavari*
- (2) *Gourami, Royans and Ankona*
- (3) *Minorka, Ankona and Giriraja*
- (4) *Muscovi, Royans and Jamnapuri*

17. Importing better varieties and plants from outside and acclimatizing them to local environment.

- (1) Selection (2) Cloning
- (3) Introduction (4) Heterosis

18. The term heterosis means

- (1) Appearance of spontaneous mutation
- (2) Inducing mutations
- (3) Mix of two or more traits
- (4) Superiority of hybrids over their parents

19. The biofertilizer present in the roots of legumes is

- (1) *Anabaena* (2) *Rhizobium*
- (3) *Azospirillum* (4) All 1, 2 and 3

20. Vermicompost biofertilizer is rich in

- (1) Phosphorus (2) Calcium
- (3) Nitrogen (4) All 1, 2 and 3

21. Different types of manures are

- (1) Farmyard, composite and green
- (2) Green and farmyard
- (3) Green and composite
- (4) Farmyard and composite

22. Consider the following statements

- A. The common organic pesticides are tobacco decoction and neem kernel suspension.
- B. Trichocards are the biological control mechanisms of pests.
- C. *Pseudomonas* are widely used in trichocards.
- D. Traps and burning torches are used for the mechanical control of pests and bugs.

The correct statements are given in

- (1) A, B, C and D (2) A, B and D
- (3) B, C and D (4) A and B

23. Plants which are used as green manure is

- (1) *Leucaenia* (2) *Subabul*
- (3) *Sesbania* (4) All 1, 2 and 3

24. Raising of plants from the isolated plant cells in a controlled nutrient medium is known as

- (1) Hydroponics (2) Tissue culture
- (3) Protoplast fusion (4) Cell culture

25. Pulses lack aminoacids like

- (1) Cysteine and Methionine
- (2) Methionine and Tryptophan
- (3) Cysteine and Tryptophan
- (4) Methionine and Phenyl alanine

26. Modification and adjustment of an organism to local area is known as

- (1) Introduction (2) Selection
- (3) Acclimatization (4) Breeding

27. Statements

- A. Ammonia is the major source of nitrogenous fertilizer in plants.
- B. Biofertilizer culture of *Azobacter* is available in the market and it is highly effective for crops like coconut, tapioca, sugar cane etc.
- C. The special type of cell known as heterocyst, present in the nitrogen fixing blue-green algae is responsible for atmospheric nitrogen fixation in *Azolla*.
- D. Mycorrhizal fungi help the plants to get phosphorus fertilizer.

The totally correct statements are

- (1) C and D (2) A and C
- (3) A, B and C (4) A, B, C and D

28. Breeding crops with higher level of proteins, minerals and vitamins is called

- (1) Biofortication (2) Eutrophication
- (3) Hybridization (4) Biomagnification

29. Technology that involves purposeful manipulation of plant species for the development of high yielding and disease resistant varieties.

- (1) Green revolution
- (2) Plant breeding and introduction
- (3) Conventional plant breeding
- (4) Hybridization and mutation breeding

30. Breeding between same breed of animals is called
 (1) Out breeding (2) Interbreeding
 (3) Inbreeding (4) Out crossing
31. *Sonalika Kalyan Sona* are the varieties of
 (1) Wheat (2) Rice
 (3) Maize (4) Ragi
32. A group of animals related by descent and similar in most characters are said to be
 (1) Clone (2) Variant
 (3) Breed (4) Variety
33. Animal husbandry and plant breeding play a major role in our efforts to increase
 (1) Food production
 (2) Disease-resistant varieties
 (3) Hybrids
 (4) All 1, 2 and 3
34. Which of the following bacterium is used as a biopesticide?
 (1) *Bacillus aureus* (2) *Bacillus thuringiensis*
 (3) *Bacillus polymyxa* (4) *Bacillus anthracis*
35. Method of preserving favourable variants and eliminating undesirable plants is termed as
 (1) Selection (2) Hybrid
 (3) Hybridization (4) Somatic hybrids
36. Consider the following statements about tissue culture.
 A. Plants produced are genetically identical to their original plant.
 B. Large number of plant-lets can be produced by plant tissue culture.
- C. Whole plant could be generated from any living part of the plant.
 D. Recovery of healthy plants from an infected plant.
- The correct statements are given in
 (1) A, C and D (2) B and D
 (3) A, B, C and D (4) A, B and D
37. The success rate of artificial insemination in animal breeding can be improved by
 (1) Inter specific hybridization
 (2) Multiple ovulation embryo transfer technology.
 (3) Out crossing
 (4) Test-tube baby programme
38. Classical plant breeding involves
 (1) Crossing or hybridization of pure lines
 (2) Artificial selection to produce plants with desired qualities.
 (3) Better yield, nutrition and resistance to disease
 (4) All 1, 2 and 3
39. Mule is the inter specific breed of
 (1) Female donkey and male horse
 (2) Male donkey and female horse
 (3) Male sheep and female horse
 (4) Male horse and female sheep
40. The term 'totipotency' means
 (1) A group of animals of unrelated characters.
 (2) The capacity of a cell to regenerate into a whole plant.
 (3) Hybrids formed as a result of somatic hybridization.
 (4) Sexually produced offsprings.

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

1. 2	2. 4	3. 1	4. 4	5. 1	6. 3	7. 1	8. 3	9. 2	10. 4
11. 1	12. 3	13. 1	14. 2	15. 3	16. 4	17. 2	18. 3	19. 2	20. 1
21. 4	22. 2	23. 3	24. 2	25. 4	26. 2	27. 3	28. 4	29. 2	30. 1
31. 4	32. 2	33. 3	34. 3	35. 2	36. 1	37. 3	38. 4	39. 3	40. 3

PRACTICE EXERCISE 11 (B)

1. 2	2. 1	3. 3	4. 2	5. 3	6. 1	7. 3	8. 4	9. 4	10. 1
11. 3	12. 2	13. 4	14. 1	15. 1	16. 3	17. 3	18. 4	19. 2	20. 4
21. 1	22. 1	23. 4	24. 2	25. 1	26. 3	27. 4	28. 1	29. 4	30. 3
31. 1	32. 3	33. 4	34. 2	35. 1	36. 3	37. 2	38. 4	39. 2	40. 2

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HISTORY

PART 6

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The Rise of Nationalism in Europe

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- Which of the following revolutions is associated with personification of Statue of Liberty as female figure?
 - American Revolution
 - French Revolution
 - Russian Revolution
 - German Revolution

- Which of the following colours is not present in German flag?

(1) Blue	(2) Black
(3) Red	(4) Gold

- Match the entries in Column I with those in Column II.

Column I

- (A) French Revolution
- (B) Napoleons invasion
- (C) Fall of Napoleon
- (D) Revolution in Europe

Column II

- I. 1797
- II. 1848 of Italy
- III. 1789
- IV. 1815

- A - III, B - I, C - IV, D - II
- A - II, B - IV, C - I, D - III

- A - III, B - IV, C - I, D - II
- A - II, B - I, C - IV, D - III

- French revolution was preceded by which of the following wars?

- American war of Independence
- Nepolinic wars
- Russian revolution
- Unification of Germany

- Which of the following statement is true regarding the territories of Eastern and Central Europe in 18th century?

- They belonged to different ethnic groups.
- They shared common language.
- They had equal economic status.
- They had common allegiance to the emperor.

- What were the Italian speaking provinces in the territory of Austria-Hungary?

- Lombardy and Venetia
- Tyrol and Bohemia
- Hungary and Galicia
- Cryotia and Transylvania

7. Which of the following invasions of Napoleon proved disastrous for Napoleon's regime in France in later period?
 - (1) Invasion of Austria
 - (2) Invasion of Britain
 - (3) Invasion of Russia
 - (4) Invasion of Italy
8. Name the place associated with the final exile of Napoleon and his death.
 - (1) Waterloo
 - (2) Paris
 - (3) Elba
 - (4) St Helena
9. The term 'liberalism' used during French revolution takes origin from which of the following languages?
 - (1) English
 - (2) Latin
 - (3) French
 - (4) German
10. When did France become a democratic republic?
 - (1) 1799
 - (2) 1871
 - (3) 1869
 - (4) 1900
11. Name the customs union formed by the German states in later part of 18th century.
 - (1) Elle
 - (2) la patrie
 - (3) le citoyen
 - (4) Zollverein
12. What was the objective of creation of Estates General?
 - (1) Motivating people for French revolution
 - (2) Framing a written constitution for France
 - (3) Achieving parity in economic policies for nobles and common public
 - (4) All of these
13. The then region of Sudetanland which was a part of territory of Austria-Hungary now belongs to which of the following countries?
 - (1) Germany
 - (2) France
 - (3) Hungary
 - (4) Czechoslovakia
14. What were the positive achievements of Zollverein?
 - (1) It reduced the number of currencies
 - (2) It abolished tariff barriers
 - (3) It abolished customs duties on goods
 - (4) Both (1) and (2)
15. After the defeat of Napoleon, the European powers (Prussia, Britain, Russia, Austria) met at a place to draw up a settlement for Europe. Name the place.
 - (1) Versailles
 - (2) Vienna
 - (3) Paris
 - (4) Moscow
16. Which of the following state was created as boundary for France after the restoration of Bourbon dynasty in France?
 - (1) Switzerland
 - (2) Spain
 - (3) Poland
 - (4) Netherlands
17. Which of the following territories was given to Russia as a result of Treaty of Vienna?
 - (1) Hungary
 - (2) Poland
 - (3) Belgium
 - (4) Saxony
18. Present day Belgium was part of which European country in early 18th century?
 - (1) Britain
 - (2) Russia
 - (3) Germany
 - (4) Netherlands
19. What was the major criticism of liberal-nationalists of French revolution on the new conservative order of Europe?
 - (1) There was no unified Europe
 - (2) There was economic exploitation of peasants and workers
 - (3) There were no proper economic policies for Europe
 - (4) There was no freedom of press
20. Which of the following statements were true regarding Giuseppe Mazzini?
 - (1) He was sent into exile for attempting a revolution
 - (2) He founded some underground societies
 - (3) He conceived the unification of Italy
 - (4) All the above
21. In which of the following countries is the erstwhile Prussia now?
 - (1) France
 - (2) United Kingdom
 - (3) Belgium
 - (4) Germany
22. What was the common feature in the organizations namely Carbonari, Young Italy and Young Europe?
 - (1) Secret societies of revolutionaries founded by liberals
 - (2) Organizations which worked for political unification of European countries
 - (3) Political parties in the new Republics of France, Germany and Italy
 - (4) Organizations which worked for political rights for women

23. Which of the following treaties was associated with the liberation of Greece from Ottoman Empire?
- (1) Treaty of Versailles
 - (2) Treaty of Vienna
 - (3) Treaty of Constantinople
 - (4) Treaty of Leoben
24. Which of the following territories did not exist as an Independent nation in 18th century?
- (1) Prussia
 - (2) Netherlands
 - (3) Hungary
 - (4) Poland
25. Who was proclaimed as King of Unified Italy in 1861?
- (1) Victor Emmanuel II
 - (2) Otto von Bismarck
 - (3) Kaiser William I
 - (4) Louis Philippe
26. Which of the following was not an administrative reform introduced by Napoleon in France?
- (1) Extension of political rights to women
 - (2) Abolition of serfdom
 - (3) Standardization of weights and measures
 - (4) Abolition of feudal system
27. July revolution of 1830 resulted in which of the following significant landmarks?
- (1) Creation of United Kingdom of Netherlands
 - (2) Breaking away of Belgium from Netherlands
 - (3) Breaking away of Luxemburg from Netherlands
 - (4) Both (2) and (3)
28. Which of the following Balkan states was not a part of Yugoslavia?
- (1) Serbia
 - (2) Croatia
 - (3) Greece
 - (4) Montenegro
29. Which of the following statements regarding Balkan states was true?
- (1) The inhabitants of Balkan states were called Slaves.
 - (2) Balkan States were part of Ottoman.
 - (3) In most of the Balkan States, communist regime was established in later days.
 - (4) All of these
30. Which of the following European powers was dominant in Balkan States?
- (1) Austria
 - (2) Russia
 - (3) Prussia
 - (4) France

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Identify the correct chronological order of the western countries which became nation states.
 - (A) Switzerland
 - (B) France
 - (C) Germany
 - (D) United States
 - (E) Russia
 - (1) DABEC
 - (2) DABCE
 - (3) ADBEC
 - (4) ADBCE
2. Identify the colours of national flag of France and Germany which are part of Olympics flag.
 - (1) Blue, red
 - (2) White
 - (3) Black
 - (4) Red
3. Which of the following were the major consequences of French revolution?
 - (A) Establishment of democratic republic in France
 - (B) Establishment of Napoleon's regime in France
 - (C) Abolition of feudal system in other European countries
 - (D) Political freedom in other European countries
 - (1) B and C
 - (2) D and B
 - (3) A and D
 - (4) A and C
4. Vienna Peace Settlement is associated with which of the following consequences?
 - (1) Establishment of Napoleonic Code
 - (2) Fall of Napoleon
 - (3) End of Napoleonic wars
 - (4) Outbreak of World War I
5. What was the major language spoken in Hungary in early 18th century?
 - (1) German
 - (2) Polish
 - (3) Magyar
 - (4) French

6. Napoleonic wars indirectly laid foundation for which of the following wars in Europe in the later period?
 - (1) World War I
 - (2) World War II
 - (3) Balkan wars
 - (4) Franco-Prussian war
7. Identify the name of the place where Napoleon was ultimately defeated in a war.
 - (1) Waterloo
 - (2) Paris
 - (3) Elba
 - (4) St Helena
8. Which of the following territories Napoleon proclaimed as Emperor apart from France?
 - (1) Prussia
 - (2) Austria
 - (3) Italy
 - (4) Netherlands
9. Which of the following dynasties immediately followed the fall of Napoleon in France?
 - (1) Bourbon dynasty
 - (2) Capetian dynasty
 - (3) None of these
 - (4) Corsican dynasty
10. What were the major problems faced by the traders during Napoleon's regime?
 - (1) High taxes were imposed on the goods
 - (2) Transport and communication systems were obsolete
 - (3) The system of weights and measures was different at different places
 - (4) The traders had to pay customs duty many times
11. Which of the following terms signifies the ideas of French revolution that means 'the fatherland'?
 - (1) Elle
 - (2) la patrie
 - (3) le citoyen
 - (4) Zollverein
12. Estates General had been renamed as
 - (1) National Assembly
 - (2) General Assembly
 - (3) Third Estate
 - (4) National Council
13. What was the common feature shared by the people of Bohemia and Sudetanland?
 - (1) The people were Italian speaking
 - (2) The people were German speaking
 - (3) Both were part of Hungary
 - (4) Both were part of Austria
14. Which among the European countries was not a part of the allied group which defeated Napoleon?
 - (1) Austria
 - (2) Prussia
 - (3) Britain
 - (4) Germany
15. What was the main objective of Treaty of Vienna?
 - (1) Restoration of previous condition of Europe
 - (2) Unification of all European countries
 - (3) Establishment of democratic set ups in all European countries
 - (4) Settlement of Peace treaties among European countries
16. Which country was given control over northern part of Italy as a result of Treaty of Vienna?
 - (1) Russia
 - (2) Prussia
 - (3) Austria
 - (4) Britain
17. What was the fate of the territory of Saxony after the Treaty of Vienna?
 - (1) It was part of Netherlands
 - (2) It was given to Russia
 - (3) It was given to Prussia
 - (4) It was created as a separate country
18. Which of the following was a true statement regarding Treaty of Vienna?
 - (1) It imposed harsh terms on France
 - (2) It left the German Federation undisturbed
 - (3) It did not create any new territories in Europe
 - (4) All the territories under French control were shared by allies
19. To which of the following territories did the revolutionary Giuseppe Mazzini belong?
 - (1) Poland
 - (2) France
 - (3) Germany
 - (4) Italy
20. The region of Greece was part of which of the following countries till 18th century?
 - (1) British Empire
 - (2) Ottoman Empire
 - (3) German Empire
 - (4) French Empire
21. Which of the following words were uttered by Austrian Chancellor Duke Metternich?
 - (1) Giuseppe Mazzini was the most dangerous enemy of our social order.
 - (2) When France sneezes, rest of the world catches cold.
 - (3) Equality between sexes would only endanger harmony and destroy dignity of the family.
 - (4) None of these

22. Who was the head of the Constitutional monarchy formed in France in 1830?
 (1) Louise Napoleon (2) Louise Phillippe
 (3) Metternich (4) Giuseppe Mazzini
23. Name the English Poet who supported Greece revolutionary movement and even participated in it?
 (1) William Shakespeare
 (2) P.B. Shelly
 (3) Robert Frost
 (4) Lord Byron
24. Who among the following was the architect of Prussian liberation movement and its unification with Germany?
 (1) Ottovon Bismarck
 (2) Kaiser William I
 (3) Victor Emmanuel II
 (4) Louis Philippe
25. Which among the following European countries was a part of United Kingdom of Great Britain apart from England?
 (1) Netherland (2) Ireland
 (3) Scotland (4) Both (2) and (3)
26. In which of the following places did the official unification of Germany as Nation state in 1871 took place?
 (1) Brussels in Germany
 (2) Benn in Prussia
 (3) Moscow in Russia
 (4) Versailles in France
27. Who among the following was not associated with the unification of Italy?
 (1) Giuseppe Mazzini
 (2) Victor Emmanuel II
 (3) Giuseppe Garibaldi
 (4) None of these
28. Which of the following Balkan states was associated with the major cause of World War?
 (1) Bosnia-Herezgovina
 (2) Romania
 (3) Macedonia
 (4) Albania
29. Identify the false statements regarding British Empire from the following.
 (A) Ireland was forcibly incorporated into Great Britain.
 (B) The nation-state of Britain came into existence much before the nation states of other European countries.
 (C) Scotland was not a part of Great Britain in 17th century.
 (D) In Ireland, English helped the Catholics to dominate over the Protestants.
 (1) A and B (2) B and C
 (3) A and D (4) C and D
30. Identify the country which was not associated with the three wars over seven years which were fought in the context of unification of Germany.
 (1) Austria (2) Denmark
 (3) France (4) Britain

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 2	2. 1	3. 1	4. 1	5. 4	6. 1	7. 3	8. 4	9. 2	10. 2
11. 4	12. 2	13. 4	14. 4	15. 2	16. 4	17. 2	18. 4	19. 2	20. 4
21. 4	22. 2	23. 4	24. 2	25. 1	26. 1	27. 4	28. 3	29. 2	30. 1

PRACTICE EXERCISE 1 (B)

1. 2	2. 1	3. 1	4. 3	5. 3	6. 1	7. 1	8. 3	9. 1	10. 3
11. 2	12. 1	13. 3	14. 4	15. 1	16. 3	17. 3	18. 2	19. 4	20. 2
21. 2	22. 2	23. 4	24. 1	25. 2	26. 4	27. 3	28. 1	29. 4	30. 4

The Nationalist Movement in Indo-China

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which of the following countries was not a part of French Indo-China?
(1) Vietnam (2) China
(3) Combodia (4) Laos
2. Which of the following reasons could be attributed to the name Indo-China?
(1) The people shared the culture of India and China
(2) The majority of people were migrants from India and China
(3) They shared the same dynastic rule with India and China in the early history
(4) They are geographically located between India and China
3. The countries of Indo-China were under the imperial rule of which of the following countries?
(1) British (2) French
(3) Germany (4) China
4. Which of the following wars resulted in the formation of Union of Indo-China in 1887?
(1) Franco-Prussian war
(2) Franco-Chinese war
(3) Indo-Thai war
(4) Indo-French war
5. Identify the territory which was joined in Indo-China later.
(1) Tonkin (2) Combodia
(3) Cochin China (4) Laos
6. The capital of Tunkin, Hanoi was on the banks of which of the following rivers?
(1) Mekong river
(2) Black river
(3) Cau river
(4) Red river
7. What is the present name of erstwhile Siam?
(1) Vietnam (2) Combodia
(3) Thailand (4) Burma
8. Vietnam became the third largest exporter of which of the following products under the French rule?
(1) Coffee (2) Rice
(3) Rubber (4) Cotton

9. Which of the following dynasties was deposed by French for taking Indo-China into its control?
 - (1) Nguyen dynasty
 - (2) Mac dynasty
 - (3) Le dynasty
 - (4) Hong Bang dynasty
10. Why did French want to introduce French education in Vietnam?
 - (1) French wanted local people for administration
 - (2) French wanted to industrialize Vietnam
 - (3) French wanted to alienate Vietnamese from Chinese culture
 - (4) All the above
11. Scholar's Revolt of 1868 was mainly against
 - (1) imposition of French education in Vietnam
 - (2) economic reforms introduced by French
 - (3) land reforms introduced by French
 - (4) imposition of Christianity in Vietnam
12. Who was the founder of the Hoa Hao movement?
 - (1) Phan Boi Chau (2) Huynh Phu So
 - (3) Lian Qichao (4) Phan Chu Trinh
13. To which of the following was Prince Cuong De associated?
 - (1) Founder of Revolutionary Society
 - (2) Adviser of Phan Boi Chau
 - (3) Founder of Hoa Hao movement
 - (4) President of Revolutionary Society
14. What was the common feature between the ideologies of Phan Boi Chau and Phan Chu Trinh?
 - (1) Both wanted to establish Democratic republic in Vietnam
 - (2) Both wanted to establish constitutional monarchy in Vietnam
 - (3) Both of them wanted to drive away French rule
 - (4) Both wanted to industrialize Vietnam with the help of French
15. Name the Association organized by Vietnamese students who founded it with the inspiration of political developments in China.
 - (1) Ngo Dinh Diem
 - (2) Viet Nam Doc Lap Dong Minh
 - (3) Duy Tan Hoi
 - (4) Viet Nam Quan Phuc Hoi
16. The League for the Independence of Vietnam popularly known as Vietminh was associated with which of the following achievements in 1945?
 - (1) Recapture of Vietnam from French.
 - (2) Establishment of Communist government in Vietnam.
 - (3) Recapture of Hanoi from Japan.
 - (4) Splitting of Vietnam into North and South.
17. In South Vietnam, Bao Dai regime was overthrown by
 - (1) a coup led by Ngo Dinh Diem.
 - (2) a revolution led by National Democratic Front.
 - (3) assassination of Bao Dai.
 - (4) a coup led by Ho Chi Minh.
18. What was the reason for the entry of US into Vietnam war?
 - (1) US wanted unification of North and South Vietnam.
 - (2) US wanted to establish a colonial rule in Vietnam.
 - (3) US was against the dictatorial regime led by Ngo Dinh Diem.
 - (4) US was worried about communist domination in Asian countries.
19. Which of the following is associated with Ho Chi Minh trail?
 - (1) Asylum for South Vietnamese in North Vietnam.
 - (2) A revolution lead by Ho Chi Minh in South Vietnam.
 - (3) Network of roads for transportation of men and materials from north to south.
 - (4) Attack of Vietnam on US.
20. Arrange the following events in the correct chronological order.
 - (A) Occupation of Saigon by NLF
 - (B) Paris Peace Agreement
 - (C) Geneva Peace Agreement
 - (D) Bombing of Hanoi by US
 - (1) CDBA (2) CBAD
 - (3) BDCA (4) BCAD
21. Which of the following was the immediate consequence of Paris Peace Settlement in 1974?
 - (1) Formation of Unified Vietnam
 - (2) End of US-Vietnam war
 - (3) End of Saigon regime in South Vietnam
 - (4) All the above

22. The year 1975 in the history of Vietnam marks a significant event. Identify.
- (1) End of colonial rule of French
 - (2) Establishment of democratic republic in North Vietnam
 - (3) Formation of unified Vietnam
 - (4) End of communist regime in Vietnam
23. Vietnam had to fight wars and uprisings with various countries, name the country which does not belong to that category?
- (1) Great Britain
 - (2) Thailand
 - (3) Japan
 - (4) US
24. What was the effect of telecasting battle scenes on TV shows and news relays?
- (1) US actions could gain support of Vietnamese
 - (2) US could get support from US citizens for the war
 - (3) North Vietnamese could gain support from Europeans
 - (4) None of these
25. Which of the following event was responsible for Cambodia and Laos to be created as separate nations from Indo-China?
- (1) Geneva accord
 - (2) Paris peace pact
 - (3) Indo-China agreement
 - (4) Treaty of Vietnam
26. When Vietnam was split, a city which was the capital of former Indo-China territories became capital city for South Vietnam. What was the name of the territory?
- (1) Cochinchina
 - (2) Tonkin
 - (3) Anam
 - (4) Laos
27. Name the capital of Indo-China that was shifted from Saigon to another city.
- (1) Hanoi
 - (2) Ho Chi Minh
 - (3) Hue
 - (4) Phnom Penh
28. Who among the following were depicted as rebels in the play written by Phan Boichau?
- (1) Trieu Au
 - (2) Trung sisters
 - (3) Nguyen Thi Xuan
 - (4) All of these
29. Which of the following events in the union of Indo-China was contemporary to the end of Second World War?
- (1) Formation of Democratic Republic of Vietnam
 - (2) Capture of Vietnam by Japan
 - (3) Signing of Geneva Accord
 - (4) Withdrawal of US troops from Vietnam
30. Which of the following made Vietnam to take Japan as a source of inspiration?
- (1) Industrialization
 - (2) Resistance to colonialization
 - (3) Victory over Russia
 - (4) All the above

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which of the following similarity do you find between Indo-China and India?
 - (A) Indo-China and India were under colonial rule of European countries.
 - (B) Indo-China and India became independent republics in the same year.
 - (C) Indo-China and India were peninsular countries.
 - (D) Both the countries are neighbouring countries to each other.
2. To which of the following regions does Union of Indo-China belong?
 - (1) South East Asia
 - (2) South West Asia
 - (3) North East Asia
 - (4) North West Asia
3. The territories of Indo-China were under the rule or control of different countries in history. Which of the following country was not in that category?
 - (1) Japan
 - (2) Russia
 - (3) China
 - (4) France

4. Name the territory which was taken into control by French before 1887.
 - (1) Tumkin (2) Anam
 - (3) Cochin China (4) Laos
5. Identify the territory which is not a part of present Vietnam.
 - (1) Tonkin (2) Anam
 - (3) Cochin China (4) Laos
6. Which of the following delta regions contributed much to the economy of French Indo-China?
 - (1) Mekong delta (2) Scugon delta
 - (3) Black river delta (4) Cauriver delta
7. With which of the neighbouring countries Indo-China fought a war?
 - (1) China (2) Burma
 - (3) Indonesia (4) Thailand
8. The colonial economy of Vietnam depended largely on which of the following crops?
 - (1) Rice, rubber (2) Rice, Coffee
 - (3) Rubber, Coffee (4) Cotton, wheat
9. The name 'Annanese Student' is associated with which of the following?
 - (1) A political party in Vietnam
 - (2) A revolutionary organization in Indo-China
 - (3) A nationalist journal in Vietnam
 - (4) Student organization in Vietnam
10. Name the dreadful disease that struck the city of Hanoi.
 - (1) Dysentery (2) Cholera
 - (3) Small pox (4) Plague
11. Name the places associated with killing of Catholics on a large scale.
 - (1) Ho Chi Minh, Hanoi (2) Phnom Phen, Yunan
 - (3) Ngu An, Ha Tien (4) None of these
12. Who was the author of the famous book 'The History of Vietnamese'?
 - (1) Huynh Phu So (2) Phan Boi Chau
 - (3) Phan Chu Trinh (4) Lian Qichao
13. Which of the following statements is false regarding Huynh Phu So?
 - (1) French revolutionaries called him 'Mad Bonze'.
 - (2) He was exiled to Laos by French
 - (3) He was declared mentally unsound by French doctors
 - (4) He opposed some of the social customs and practices prevalent in Vietnam
14. In which of the following places outside the Indo-China union, did Vietnamese establish a branch of the Restoration Society of Vietnam?
 - (1) Tokyo (2) Beijing
 - (3) Hanoi (4) Phnom Penh
15. The provinces of Vietnam namely Nghe An and Ha Tinh were called the electrical fuses of Vietnam because
 - (1) they were the richest provinces
 - (2) they were the first to blow in times of crisis
 - (3) they do not get disturbed due to any uprisings
 - (4) they were the provinces to get industrialized first
16. Which of the following was the direct consequence of Geneva Agreement?
 - (1) Unification of North and South Vietnam
 - (2) Restoration of Nguyen dynasty in Vietnam
 - (3) Entry of US in the political scene of Vietnam
 - (4) Splitting of Vietnam into south and North
17. Which of the following statements regarding Ho Chi Minh were true?
 - (1) He was the Head of Democratic Republic of North Vietnam.
 - (2) He established Vietnamese Communist Party.
 - (3) Under his leadership, Ngo Dinh Diem overthrew Bao Dai's regime.
 - (4) He was against unification of North and South Vietnam.
18. Which of the following is associated with the term Napalm?
 - (1) Most powerful phosphorous bomb used by US against Vietnam.
 - (2) Chemical weapon used in WW II and in Vietnam war.
 - (3) A type of atom bomb used by US in Vietnam war.
 - (4) A heavy weapon used by US against Vietnam.
19. Which of the following statements regarding Ho Chi Minh trial is correct?
 - (1) Most part of the trail was through Laos and Combodia

- (2) The trail had support bases like hospitals
 (3) The trail was obstructed after 1967 as US bombings destroyed the supply line
 (4) None of these
20. Which of the following places is associated with the peace settlement between Vietnam and US?
 (1) Geneva (2) Saigon
 (3) Ho Chi Minn city (4) Paris
21. Which of the following wars was called the First Television War?
 (1) Indo-French war (2) Indo-Thai war
 (3) Japan-Vietnam war (4) US-Vietnam war
22. The place in Vietnam, Dien Bien Phu was associated with which of the following events?
 (1) Defeat of French by Vietnam
 (2) Defeat of US by Vietnam
 (3) Occupation of presidential palace in south Vietnam
 (4) It was the capital of newly formed South Vietnam
23. With which of the following the name 'Agent Orange' is associated?
 (1) A secret society of South Vietnam
 (2) A Nationalist journal of Vietnam
 (3) A deadly poison and defoliant used by US
 (4) A secret agency of US to crush revolutionary Vietnamese
24. Which of the following cities was renamed as Ho Chi Minh city after unification of Vietnam?
 (1) Hanoi (2) Saigon
 (3) Hue (4) Danang
25. In which of the following years was French Indo-China deunified?
 (1) 1975 (2) 1945
 (3) 1954 (4) 1967
26. What was the capital city of Union of Indo-China when it was formed in 1887?
 (1) Ho Chi Minh city (2) Hanoi
 (3) Saigon (4) Mekang
27. Which of the following statements was false regarding Trieu Au?
 (1) She organized a large army and resisted Chinese rule
 (2) She died by drowning herself
 (3) She was worshipped as a sacred figure in Vietnam
 (4) She was a contemporary of Ho Chi Minh
28. With which of the following significances was the woman rebel 'Nguyen Thi Xuan' associated?
 (1) She fought against chinese rule in 3rd century BC
 (2) She was a nationalist in NLF
 (3) She shot down a US jet with just 20 bullets
 (4) She was responsible for fall of Bao Dai's regime
29. Political developments in which of the Asian countries became the source of inspiration for Vietnam to fight for the achievement of Democratic Republic?
 (1) Japan (2) India
 (3) China (4) Pakistan
30. In which of the following countries did Vietnamese students of Restoration society in Japan find exile?
 (1) Combodia, Laos (2) India, Indonesia
 (3) China, Thailand (4) China, Malaysia

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 2 | 4. 2 | 5. 4 | 6. 2 | 7. 3 | 8. 2 | 9. 1 | 10. 3 |
| 11. 4 | 12. 2 | 13. 4 | 14. 3 | 15. 4 | 16. 4 | 17. 1 | 18. 4 | 19. 3 | 20. 1 |
| 21. 3 | 22. 3 | 23. 1 | 24. 3 | 25. 1 | 26. 1 | 27. 1 | 28. 2 | 29. 2 | 30. 4 |

PRACTICE EXERCISE 2 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 2 | 4. 3 | 5. 4 | 6. 1 | 7. 4 | 8. 2 | 9. 3 | 10. 4 |
| 11. 2 | 12. 4 | 13. 3 | 14. 1 | 15. 2 | 16. 4 | 17. 2 | 18. 2 | 19. 3 | 20. 4 |
| 21. 4 | 22. 1 | 23. 3 | 24. 2 | 25. 1 | 26. 3 | 27. 4 | 28. 3 | 29. 3 | 30. 4 |

Nationalism in India

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. In South Africa, Mahatma Gandhi's Satyagraha movement was mainly against
 - (1) economic exploitation.
 - (2) antireligious activities.
 - (3) racial discrimination.
 - (4) peasant problems.
2. Which of the following reasons could be attributed to the Champaran movement of 1916?
 - (1) The increased taxation on agriculture.
 - (2) The higher customs duties imposed on Indian textiles.
 - (3) The ban imposed on import of Indian indigo in England.
 - (4) The forced cultivation of indigo and other cash crops in place of food crops.
3. What was the outcome of Champaran movement?
 - (1) A law was passed which made indigo plantation compulsory.
 - (2) A law was passed exempting the farmers from indigo plantation.
 - (3) A law was passed imposing ban on indigo plantation.
 - (4) A law was passed lifting ban on the import of Indian indigo in Britain.
4. Who among the following leaders came into lime-light during the Kheda movement?
 - (1) Bal Gangadhar Tilak
 - (2) Gopala Krishna Gokhale
 - (3) Govind Vallabh Pant
 - (4) Vallabhai Patel
5. Identify the false statement regarding Rowlatt Act.
 - (1) It was passed by imperial legislative council which had no Indian representation.
 - (2) It was passed by imperial legislative council in spite of opposition from Indian members.
 - (3) Rowlatt Act allowed detention of political prisoners for a period of 2 years without trial.
 - (4) Rowlatt Act was passed in 1920 as an outcome of Khilafat movement.
6. Which of the following state was in focus during the movement against Rowlatt Act?
 - (1) Bengal
 - (2) Punjab
 - (3) Bihar
 - (4) Bombay

7. What was the main objective of Mahatma Gandhi for starting Khilafat Movement?
 - (1) Protection of rights of Muslims in other countries.
 - (2) In World War I, India was on the side of Ottoman Empire.
 - (3) Protection of minorities in India.
 - (4) Creation of broader base for the national movement.
8. Which of the following reasons could be attributed to the end of Khilafat movement?
 - (1) It was suspended by Gandhi due to the violent turn
 - (2) Caliph of Turkey got his sultanate back
 - (3) Turkey became a republic
 - (4) There was some disunity between Hindus and Muslims
9. At which congress session a compromise was worked out within congress before launching the non-cooperation movement?
 - (1) Nagpur
 - (2) Bombay
 - (3) Calcutta
 - (4) Madras
10. Arrange the following events in correct chronological order.
 - (A) Rowlatt satyagraha
 - (B) Khilafat movement
 - (C) Jalianwala bagh massacre
 - (D) Kheda movement
 - (1) DBAC
 - (2) BACD
 - (3) ABCD
 - (4) DCBA
11. Why did Indian Muslims turn against the British after World war I?
 - (1) Many Muslim soldiers were killed during the war.
 - (2) Great Britain was on the side which defeated Islamic state of Turkey.
 - (3) British failed to fulfil their promises for Muslims after the war.
 - (4) British followed the policy of divide and rule.
12. Name the place associated with the Chowri-Chowra incident.
 - (1) Bilaspur
 - (2) Gorakhpur
 - (3) Lucknow
 - (4) Amritsar
13. What was the main allegation against Simon Commission?
 - (1) The Commission was appointed by the Viceroy
 - (2) The commission was headed by British member
 - (3) The commission was not a statutory body
 - (4) The commission constituted only British members
14. Name the place associated with the formation of Khilafat Committee.
 - (1) Bombay
 - (2) Madras
 - (3) Calcutta
 - (4) Poona
15. With which of the following incident is General Dyer associated?
 - (1) Chowri-Chowra incident
 - (2) Rowlatt Act
 - (3) Duy Tan Hoi
 - (4) Jallianwala Bagh incident
16. Which of the following statements about Baba Ramchandra was correct?
 - (1) Peasants in Awadh were led by him as a part of non-cooperation movement
 - (2) He had earlier been to Fiji islands as an indentured labourer
 - (3) He was associated with Oudh Kisan Sabha
 - (4) All the above
17. Name the famous freedom fighter associated with Guerilla war of tribal regions of Andhra Pradesh.
 - (1) Alluri Seetharam Raju
 - (2) Subash Chandra Bose
 - (3) Gurajada Appa Rao
 - (4) None of these
18. Which of the following incidents made Gandhiji to suspend the Non-Cooperation movement?
 - (1) Killing of hundreds of people at Amritsar by General Dyer.
 - (2) Violent clash of agitators with police at Gorakhpur.
 - (3) Violent Guerilla War in the Hills of Andhra Pradesh.
 - (4) Forcible imposition of Rowlatt Act on the people.
19. What was the objective of the Simon Commission that was constituted by the British?
 - (1) Probe into Jalianwala Bagh massacre
 - (2) Probe into Chowri-Chowra incident
 - (3) Analyse the functioning of constitutional system in India
 - (4) Both (1) and (2)
20. The Viceroy of India at the time of Simon Commission was
 - (1) Lord Ripon
 - (2) Lord Dalhousie
 - (3) Lord Irwin
 - (4) Lord Canning

21. A member of Simon Commission later became Prime Minister of Britain who supported granting of independence to India. He was
 (1) Lord Mountbatten (2) Lord Irwin
 (3) Ramsey Mc Donald (4) Clement Attlee
22. Suspension of Civil Disobedience Movement resulted in which of the following?
 (1) Gandhi-Irwin Pact
 (2) Poona Pact
 (3) Government of India Act 1919
 (4) Government of India Act 1935
23. Match the entries of Column I with those in Column II.
- | Column I | Column II |
|-----------------------|------------|
| (A) Dandi March | (i) 1921 |
| (B) Khilafat movement | (ii) 1928 |
| (C) Simon Commission | (iii) 1930 |
| (D) Purna Swaraj | (iv) 1929 |
- (1) A - iii, B - i, C - ii, D - iv
 (2) A - i, B - iii, C - ii, D - iv
 (3) A - iii, B - ii, C - i, D - iv
 (4) None of these
24. The famous book *Hind Swaraj* was written by
 (1) Jawaharlal Nehru
 (2) Subhash Chandra Bose
 (3) Mahatma Gandhi
 (4) Bal Gangadhar Tilak
25. Which of the following statements regarding Dandi March was false?
 (1) It was the initial phase of Civil Disobedience Movement.
 (2) The march was from Dandi to Sabarmati in Gujarat.
 (3) It was against the monopoly of Government production of salt.
 (4) None of these
26. Why did Patidars of Gujarat and the Jats of UP participate in the Civil Disobedience Movement?
 (1) They wanted to own the land holdings they were cultivating.
 (2) They wanted to cultivate food crops instead of cash crops.
 (3) They wanted reduction in the taxes on agricultural income.
 (4) They wanted remission of rents on their landholdings.
27. What was the common similarity between Purushottamdas Thakurdas and G.D.Birla?
 (1) Both of them led peasant movements in Gujarat and UP.
 (2) They were prominent members of FICCI.
 (3) Both of them did not lend support to Civil Disobedience Movement.
 (4) They were socialist leaders who led the working class in the movement.
28. In what aspect, B.R. Ambedkar differed with Mahatma Gandhi?
 (1) Reservations for depressed classes.
 (2) Separate electorates for Dalits.
 (3) Inclusion of Dalits in the Civil Disobedience movement.
 (4) Giving voting rights to Dalits.
29. Who was the founder of Muslim League?
 (1) Muhammad Ali Jinnah.
 (2) Khan Abdul Gafarkhan.
 (3) Muhammad Iqbal.
 (4) Shaukat Ali.
30. Our national song, Vande mataram was taken from which of the following novels?
 (1) Geetanjali (2) Anandamath
 (3) Bharatmatha (4) None of these

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which of the following similarity do you find between Champaran movement and Kheda movement?

- A. Both movements were led by Mahatma Gandhi.
 B. Both movements took place in the same year.
 C. Both movements were associated with peasant problems.
 D. Both places were in the same presidency.

- (1) A, B (2) A, C
(3) B, D (4) B, C
2. Kheda movement was associated with
- (1) the increased taxation on agriculture at the time of famine.
(2) the higher customs duties imposed on Indian textiles.
(3) the ban imposed on import of Indian indigo in England.
(4) the forced cultivation of indigo and other cash crops in place of food crops.
3. What was the outcome of Kheda movement?
- (1) The land taxes were altogether abolished.
(2) The increased taxes were abolished.
(3) The taxes were abolished for two years.
(4) There was no change in the tax structure.
4. In 1918, along with Kheda movement in Gujarat, Gandhiji also organized another movement regarding the problems of textile mill workers. Name the place associated with the movement.
- (1) Champaran (2) Ahmedabad
(3) Calcutta (4) Poona
5. The term Satyagraha was used by Mahatma Gandhi for the first time during
- (1) Kheda movement.
(2) Champaran movement.
(3) Khilafat movement.
(4) Rowlatt movement.
6. The martial law imposed by General Dyer in Amritsar deprives the people of the following rights.
- (1) Right of assembling.
(2) Right to publish.
(3) Right to protest.
(4) Both (1) and (3)
7. Which of the following movements is associated with the defeat of Ottoman Turkey in World War I?
- (1) Rowlatt Satyagraha
(2) Chowri-Chowra movement
(3) Khilafat movement
(4) Kheda movement
8. As far as the non-cooperation movement was concerned, there was some difference of opinion within the congress. What was the issue of difference?
- (1) Surrender of titles
(2) Boycott of civil services
(3) Boycott of council elections
(4) Boycott of legislative councils
9. What was the period of Khilafat movement?
- (1) 1916-1920 (2) 1919-1924
(3) 1922-1926 (4) 1925-1930
10. Name the province in which peasants were led by Baba Ramachandra as a part of non-cooperation movement.
- (1) Jhansi (2) Meerut
(3) Satara (4) Awadh
11. Who among the following was not associated with the Khilafat movement?
- (1) Mahammad Ali Jinnah
(2) Shoukat Ali
(3) Mahammad Ali
(4) Moulana Abul Kalam
12. Who among the following formed Swaraj party within the Congress?
- (1) Motilal Nehru and Jawaharlal Nehru
(2) Motilal Nehru and C.R. Das
(3) Jawaharlal Nehru and C.R. Das
(4) Subhash Chandra Bose and C.R. Das
13. Identify a religious movement which later on took the shape of a political or freedom movement.
- (1) Champaran movement
(2) Kheda movement
(3) Rowlatt Satyagraha
(4) Khilafat movement
14. Name the place associated with Jalianwala Bagh massacre.
- (1) Lahore (2) Amritsar
(3) Patna (4) Delhi
15. The non-cooperation movement was slowed down due to some reasons. Identify the aspects in which it posed some practical problems.
- (1) Boycott of foreign cloth
(2) Boycott of British institutions
(3) Picketing of liquor shops
(4) Both (1) and (2)
16. A militant guerilla struggle spread in 1920 in the Gudem Hill of which state?
- (1) Bihar (2) Mysore
(3) Andhra Pradesh (4) Madhya Pradesh

17. Which of the following was prevented according to Inland Emigration Act of 1859?
- (1) Entry of workers of tea plantations into the tea gardens without permission
 - (2) Entry of other Indians into the tea gardens
 - (3) Entry of British officials into the tea gardens
 - (4) Entry of workers of tea plantations into the neighbouring villages
18. Which of the following is associated with the term Napalm?
- (1) Most powerful phosphorous bomb used by US against Vietnam.
 - (2) Chemical weapon used in WW II and in Vietnam war.
 - (3) A type of atom bomb used by US in Vietnam war.
 - (4) A heavy weapon used by US against Vietnam.
19. The demand of Purna Swaraj was conceptualized in the Congress session at
- (1) Ahmedabad
 - (2) Surat
 - (3) Bombay
 - (4) Lahore
20. Which of the following statements was true regarding the round table conferences?
- (1) The 1st Round Table Conference was the outcome of Gandhi-Irwin Pact
 - (2) The Congress boycotted the 1st Round Table conference
 - (3) 2nd Round Table Conference was the only conference attended by the Congress and Muslim League
 - (4) 3rd Round Table Conference was attended by Muslim League
21. What was the consequence of 2nd Round Table Conference?
- (1) Gandhi-Irwin Pact
 - (2) Poona Pact
 - (3) Government of India Act 1919
 - (4) Government of India Act 1935
22. Who was the viceroy of India when Indian National Congress was formed?
- (1) Lord Dufferin
 - (2) Lord Canning
 - (3) Lord Wellesley
 - (4) Lord Ripon
23. In Lahore session of congress, the demand for Purna Swaraj was declared and tentative day of celebration of independence day was given as
- (1) 26 January 1930
 - (2) 15 August 1930
 - (3) 26 January 1945
 - (4) 15 August 1945
24. The Viceroy who announced the dominion status for India in future was
- (1) Lord Dufferin
 - (2) Lord Irwin
 - (3) Lord Mountbatten
 - (4) Clement Attlee
25. What was Dr Ambedkar's demand in the second Round Table Conference?
- (1) Reservation of seats for depressed classes in the legislative councils
 - (2) Caste based electorates
 - (3) Separate electorates for backward classes
 - (4) None of these
26. What were the major demands of industrialists during the Civil Disobedience Movement?
- (A) Permission to establish large scale industries in India.
 - (B) Protection against import of foreign goods.
 - (C) High rupee-sterling ratio.
 - (D) Nationalization of all industries.
- (1) A, B
 - (2) B, C
 - (3) C, D
 - (4) B, D
27. Which among the following workers wore Gandhi caps and participated in boycott campaign during Civil Disobedience Movement?
- (1) Railway workers
 - (2) Workers of Singareni coal mines
 - (3) Workers of dockyards
 - (4) Workers of Chotanagpur tin mines
28. In which of the following year was the Poona pact declared?
- (1) 1932
 - (2) 1934
 - (3) 1928
 - (4) 1930
29. Who was the author of the novel, *Anandamath*?
- (1) Rabindranath Tagore
 - (2) Aurobindo Ghosh
 - (3) Abindranath Tagore
 - (4) Bankin Chandra Chatopadhyay
30. Rabindranath Tagore is associated with which of the following?
- (1) Establishment of Shanthivan
 - (2) Famous novel *Geetanjali*
 - (3) Painting of Bharatmatha
 - (4) Designing of Swaraj flag

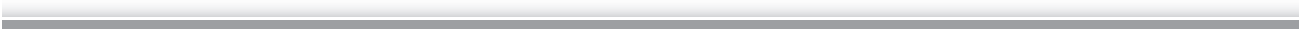
ANSWER KEYS

PRACTICE EXERCISE 3 (A)

1. 3	2. 4	3. 2	4. 4	5. 1	6. 1	7. 4	8. 3	9. 1	10. 1
11. 2	12. 2	13. 4	14. 1	15. 4	16. 4	17. 1	18. 2	19. 3	20. 3
21. 3	22. 1	23. 1	24. 3	25. 2	26. 4	27. 2	28. 2	29. 1	30. 2

PRACTICE EXERCISE 3 (B)

1. 2	2. 1	3. 3	4. 2	5. 2	6. 4	7. 3	8. 3	9. 2	10. 4
11. 1	12. 3	13. 4	14. 2	15. 2	16. 3	17. 4	18. 2	19. 4	20. 2
21. 2	22. 1	23. 1	24. 2	25. 3	26. 2	27. 4	28. 1	29. 4	30. 3



The Making of a Global World

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. In which of the following countries is Sicily island located?
(1) Austria (2) Switzerland
(3) France (4) Italy
2. In mid 1840s, many people died of starvation when potato crop was destroyed due to a particular disease. Name the country associated with the above incident.
(1) England (2) America
(3) Ireland (4) France
3. Which of the following goods found their routes from Europe to Asia?
(1) Silk (2) Porcelain
(3) Gold (4) None of these
4. Which of the following religious cults was the most ancient and the earliest in Asia?
(1) Christianity (2) Buddhism
(3) Muslim (4) Jainism
5. Which of the following countries were known to be the richest in the 18th century?
(1) India (2) Cambodia
(3) Cochin China (4) Laos
6. Corn laws which prohibited import of corn were imposed in which of the following countries?
(1) Europe (2) Asia
(3) America (4) Africa
7. The consumption of meat in European countries increased drastically after 1870. Which of the following developments indirectly resulted in the above?
(1) Invention of refrigeration technology
(2) Invention of aeroplane
(3) Development of faster ships
(4) Establishment of trade relations with Asian countries
8. Territories of which continent did not experience colonial rule by another country in their early history?
(1) Asia (2) Africa
(3) Europe (4) America
9. Which of the following countries did not establish its colonial power in any of the African territories before 1890?

- (1) Belgium (2) Germany
(3) Spain (4) US
10. US became a colonial power in Africa in the late 1890s by taking over the territories of
(1) Spain (2) Portugal
(3) Belgium (4) Italy
11. Which of the colonial powers brought the dreadful disease of Rinderpest to Africa?
(1) Spain
(2) France
(3) Germany
(4) Italy
12. What was the common feature of the territories of Trinidad, Guyana and Surinam?
(1) All of them are territories in East Africa
(2) They are part of Caribbean islands
(3) They were independent territories of Africa
(4) All of these
13. Who among the following was the first explorer to reach Caribbean islands?
(1) Vasco-da-gama
(2) Christopher Columbus
(3) Ferdinand Magellan
(4) James Cook
14. Which of the following statements regarding World War I is false?
(1) The war lasted for more than four years
(2) US economy strengthened after the war
(3) Britain, France and Germany fought on one side
(4) Ottoman Turkey was supported by Germany
15. What was the gap in time period between First World War and Second World War?
(1) 10 years (2) 7 years
(3) 15 years (4) 20 years
16. Which of the following countries was not included in Allied powers in Second World War?
(1) Soviet Union (2) US
(3) Italy (4) France
17. Which of the following issues was Bretton woods conference associated with?
(1) Post war economic system of US
(2) Establishment of World Bank
(3) Establishment of IMF
(4) Both (2) and (3)
18. What were the main features of International monetary system?
(1) Dollar had the fixed exchange rate with gold.
(2) All currencies had the fixed exchange rate with gold.
(3) Pound Sterling was taken as the standard currency.
(4) All of these
19. Name the Asian country which was benefited immediately by the establishment of IMF and World Bank.
(1) India (2) China
(3) Japan (4) All of these
20. World Bank and IMF were established in the year
(1) 1941 (2) 1944
(3) 1947 (4) 1950
21. What is the full form of NIEO?
(1) New International Environment Organization
(2) New International Economic Organization
(3) New International Economic Order
(4) New International Environment Order
22. What was the reason for the collapse of the system of fixed exchange rates?
(1) Lack of stable and rapid growth in the world economy.
(2) Rising costs of overseas establishments of US.
(3) Depreciation of other currencies with respect to dollar.
(4) All of these
23. Which of the following developments took place after 1970?
(1) Shifting of economy from fixed exchange rate to floating exchange rate
(2) Entry of China into world economy
(3) Establishment of MNCs in other countries
(4) Establishment of dollar as the principal currency
24. Which Asian country was cut off from the post-war world economy?
(1) China (2) Japan
(3) India (4) Pakistan
25. Which of the following countries were the worst hit by the Bretton Woods economy?
(1) India
(2) Japan
(3) Latin America
(4) China

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following statements are true regarding the trade in Asia?
 - (A) Food items similar to noodles had been found in India, China and Japan.
 - (B) Spaghetti was believed to be the modified form of noodles.
 - (C) The food item Pasta was believed to have been originated in Italy.
 - (D) Potatoes originated in Europe and later introduced in the West
 - (1) A and D (2) A and B
 - (3) C and D (4) B and C
2. Sicily is an island in which of the following seas?
 - (1) Mediterranean sea
 - (2) Adriatic sea
 - (3) Ionian sea
 - (4) Tyrrhenian sea
3. The vast continent which was discovered by Christopher Columbus later came to be known as
 - (1) Europe (2) Asia
 - (3) America (4) Australia
4. Name the country from which the food item Spaghetti was believed to have originated.
 - (1) Sicily (2) Italy
 - (3) China (4) France
5. What was the problem faced by the Europeans in the process of colonization for trade in Africa?
 - (1) Lack of mineral resources
 - (2) Lack of fertile agricultural land
 - (3) Lack of population
 - (4) Lack of labour
6. Which of the following continents was believed to be the oldest known one?
 - (1) Australia (2) Asia
 - (3) America (4) Europe
7. Rival European countries carved up the different territories in a continent in order to establish their colonies there. Identify the continent.
 - (1) Asia (2) Europe
 - (3) Africa (4) South America
8. Name the place where big European countries met in 1885 to complete the process of carving up of Africa among them.
 - (1) Paris (2) London
 - (3) Rome (4) Berlin
9. Identify the pair of European countries which did not have colonial control on any of the territories of Africa.
 - (1) Belgium, Italy
 - (2) Portugal, Spain
 - (3) Poland, Denmark
 - (4) None of these
10. Which of the African country was first affected by the Rinderpest diseases?
 - (1) Cape of Good Hope
 - (2) Eritria
 - (3) Nigeria
 - (4) Madagascar
11. To which of the following countries did the indentured labour from the India migrate in 19th century.
 - (1) Algeria (2) Ivory Coast
 - (3) Nigeria (4) Caribbean islands
12. What was the erstwhile name of Caribbean islands?
 - (1) East Indies (2) Fiji islands
 - (3) West Indies (4) Mauritius islands
13. The explorer who landed in Caribbean islands for the first time and named them West Indies belonged to which of the following countries?
 - (1) France (2) Spain
 - (3) Italy (4) America
14. Which of the following companies gave the first model of mass produced cars?
 - (1) Maruti (2) Ambassador
 - (3) Chevrolet (4) Ford
15. Which of the following countries was not included in Axis powers of Second World War?
 - (1) Germany (2) France
 - (3) Japan (4) Italy

16. Which of the following was the consequence of Second World War?
- (1) Creation of two power blocks
 - (2) Transformation of Soviet Union as a capitalist country
 - (3) Emergence of Japan as an industrial country
 - (4) Transformation of Germany into industrial country
17. Which of the following organizations was not set up during Bretton Woods conference?
- (1) International Monetary Fund
 - (2) International Bank for Reconstruction and Development
 - (3) World Bank
 - (4) American Express Bank
18. Which of the following events was the major turning point to shift the victory from the side of Allied powers towards Axis Powers?
- (1) Attack of Germany on Russia
 - (2) Defeat of Germany by US
 - (3) Unconditional Surrender of Japan to Axis Powers
 - (4) Occupation of France by Germany
19. Which of the following statements regarding International monetary system was incorrect?
- (1) Veto power regarding decisions of IMF and World Bank can be exercised by US
 - (2) IMF was established to finance post war reconstruction
 - (3) World Bank is popular name of International Bank for Reconstruction and Development
 - (4) None of these
20. Which of the following countries was not a member of G-77?
- (1) Germany
 - (2) India
 - (3) Japan
 - (4) Pakistan
21. The year 1947 was associated with which of the following major events in the world economic front?
- (1) Establishment of IMF
 - (2) Establishment of World Bank
 - (3) Starting of operations of IMF and World Bank
 - (4) Formation of G-77
22. What is the major attraction for MNCs in China?
- (1) Availability of talented and skilled human resources
 - (2) Availability of vast natural resources
 - (3) Low wage structure of China economy
 - (4) Suitable climatic conditions in China
23. Which of the following developments changed the world economy?
- (1) Collapse of Soviet Union
 - (2) Failure of communism in Eastern Europe
 - (3) Establishment of MNCs in Asian countries
 - (4) All of these
24. Name the organization that was established with the objective of dealing with external surpluses and deficits of its members.
- (1) IMF
 - (2) World Bank
 - (3) NIEO
 - (4) Bank of America
25. Why did the need for establishment of MNCs arise?
- (1) Lack of natural resources in their countries.
 - (2) High import tariffs imposed by different companies.
 - (3) High transport costs.
 - (4) Lack of human resources in their countries.

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

1. 4	2. 1	3. 3	4. 2	5. 1	6. 1	7. 1	8. 3	9. 4	10. 1
11. 4	12. 2	13. 2	14. 3	15. 4	16. 3	17. 4	18. 1	19. 3	20. 2
21. 3	22. 2	23. 1	24. 1	25. 3					

PRACTICE EXERCISE 4 (B)

1. 2	2. 1	3. 3	4. 3	5. 4	6. 1	7. 3	8. 4	9. 3	10. 2
11. 4	12. 1	13. 3	14. 4	15. 2	16. 1	17. 4	18. 1	19. 2	20. 1
21. 3	22. 3	23. 4	24. 1	25. 2					

The Age of Industrialization, Work, Life and Leisure: Cities in the Contemporary World

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Who was the scientist who invented the first model of steam engine but did not patent it?
(1) James Watt (2) Newcomen
(3) James Hargreaves (4) Mathew Bolton
2. Which of the following progresses resulted in greater employment opportunities in England?
(1) Expansion of railways
(2) Invention of Spinning Jenny
(3) Invention of Steam Engine
(4) None of these
3. Which of the following ports connected India to the Gulf and Red Sea Ports?
(1) Masulipatnam (2) Hoogly
(3) Madras (4) Surat
4. Monopolization of trade by the Europeans led to the decline of some ports. Name such port.
(1) Bombay (2) Calcutta
(3) Surat (4) Cochin
5. Name the city which was not associated with the establishment of cotton mills in the early part of 18th century.
(1) Bombay (2) Kanpur
(3) Ahmedabad (4) Calcutta
6. Name the industrialist who set up the first jute mill in Calcutta.
(1) Dinshaw Petit (2) Dwaraknath Tagore
(3) G.D. Birla (4) Seth Hukumchand
7. Which of the following items was exported from India to China during 18th century in exchange of tea for England?
(1) Coffee (2) Cotton
(3) Opium (4) Red Rice
8. Spinning Jenny was invented by
(1) James Watt (2) Mathew Boulton
(3) Newcomen (4) James Hargreaves

9. The term 'carding' is associated with which of the following industry?
- (1) Cotton (2) Jute
(3) Steel (4) Sugar
10. Which of the following statements regarding steam engine are true?
- (A) James watt's discovery of Steam engine got patent
(B) The usage of steam engine was very widespread in steel industry
(C) The steam engine enhanced the industrial productivity manifold
(D) Before James watt, Newcomen invented the primitive form of steam engine
- (1) A,B,C (2) A,C,D
(3) B,C,D (4) A,B,D
11. Which of the colonial powers brought the dreadful disease of Rinderpest to Africa?
- (1) Britain (2) France
(3) Germany (4) Poland
12. Identify the city which was not the presidency city in India.
- (1) Calcutta (2) Madras
(3) Bombay (4) Delhi
13. Which of the following was the consequence of Anglo-Maratha war?
- (1) Bombay came under the control of English East India Company
(2) Shifting of export base from Surat port to Bombay port
(3) Establishment of 1st cotton mill in Bombay
(4) Bombay became the capital of Bombay presidency
14. Name the first Indian city to get smoke nuisance legislation.
- (1) Bombay (2) Calcutta
(3) Madras (4) Delhi
15. In which province was Lahore city located in pre independence period?
- (1) Delhi
(2) Northwest frontier province
(3) Punjab
(4) Central provinces
16. The cotton piece production doubled between 1900–1912. Identify the reason.
- (1) First World War
(2) Swadeshi movement in India
(3) Closure of China's trade in international markets
(4) Industrialization in China
17. What is the name given to the mechanical device which puts the horizontal threads into the vertical threads?
- (1) Spinning jenney
(2) Fly Shuttle
(3) Loom
(4) Carding machine
18. Most part of the northwest frontier province is presently located in which of the following territories?
- (1) *Pakistan* (2) Punjab
(3) Delhi (4) Uttar Pradesh
19. What was the reason for the decline of old ports and development of new ports?
- (1) The old ports did not have enough facilities for trading on large scale
(2) Development of railway lines in those areas
(3) The old ports had obsolete technology
(4) The trading in old ports was controlled by Indian merchants
20. Western countries had a view point that the countries which were to the east of Mediterranean were pre-modern, traditional and mysterious. With reference to this they used a term for Asian countries. Identify the term.
- (1) Orient (2) Third World
(3) Commonwealth (4) All of these
21. What was the affect of American civil war of 1860s on the fate of cotton textile industry in India?
- (1) The prices of raw cotton declined
(2) *The prices of raw cotton shoot up*
(3) The cotton weaving became profitable
(4) There was huge surplus of raw cotton
22. First jute mill in India was set up at
- (1) Kanpur (2) Madras
(3) Bombay (4) Calcutta
23. Identify the years associated with the establishment of first cotton mill and first iron and steel plant in India.
- (1) 1874,1917 (2) 1854, 1912
(3) 1854,1917 (4) 1860, 1912

24. What was the major employer of Britain before the World War I emerged?
- (1) Clothing and footwear
 - (2) Metals and engineering
 - (3) Dockyard
 - (4) Surgical instruments
25. Who was the chief architect of new Paris when Louis Napoleon undertook the task of rebuilding of Paris?
- (1) Baron Hausmann
 - (2) Edward Jenner
 - (3) New Comenn
 - (4) Lee Kuan Yew

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following statements are true regarding the various phases of industrialization in Britain?
 - A. Before industrialization there was no large scale industrial production in England.
 - B. The first product to be industrialized in Britain was cotton.
 - C. The new technological inventions were gladly acceptable for common people.
 - D. In Britain, usage of handmade products was a symbol of aristocracy
 - (1) A and D
 - (2) A and B
 - (3) B and D
 - (4) B and C
2. Which country dominated the international trade of cotton and silk textiles in seventeenth century?
 - (1) Britain
 - (2) America
 - (3) China
 - (4) India
3. Which port in Coromandel coast had trade links with Southeast Asian ports?
 - (1) Hoogly
 - (2) Masulipatnam
 - (3) Surat
 - (4) Cochin
4. The port which gained importance in place of Hoogly during the colonial rule in India.
 - (1) Bombay
 - (2) Calcutta
 - (3) Visakhapatnam
 - (4) Madras
5. In which state, the jute mills were set up in the same period of establishment of cotton mills elsewhere in India?
 - (1) Kerala
 - (2) Karnataka
 - (3) Gujarat
 - (4) Bengal
6. Most of the successful industrialists of India in the initial days maintained trade relationships with which of the following countries?
 - (1) Britain
 - (2) Portugal
 - (3) China
 - (4) France
7. The names Bird Heiglers & Co, Andrew Yule and Jardine Skinner & Co were associated with which of the following?
 - (1) Joint stock companies set up by Indian industrialists
 - (2) Joint stock companies set up by European countries
 - (3) European agencies which controlled Indian industries
 - (4) None of these
8. Who was the author of the novel 'The Gods Visit Earth'?
 - (1) Durgacharan Ray
 - (2) Dwaraknath Tagore
 - (3) Rabindranath Tagore
 - (4) Mahatma Gandhi
9. Which of the following developments resulted in shifting of leading sector from cotton to steel?
 - (1) Invention of steam engine
 - (2) Discovery of iron metal
 - (3) Expansion of railways
 - (4) Establishment of cotton mills
10. The city of London in England is situated on the banks of which river?
 - (1) Thames
 - (2) Eden
 - (3) Kent
 - (4) Madagascar
11. What is the significance of chartist movement?
 - (1) Demanding voting rights for women
 - (2) Demanding adult male suffrage
 - (3) Demanding limited hours of work in factories
 - (4) Demanding for married women's property rights

12. Before passing into the hands of English East India company, Bombay was under the control of which European country?
- (1) France (2) Dutch
(3) Portugal (4) Spain
13. Arrange the following events in chronological order.
- (A) Shifting of base from Surat to Bombay by English East India Company
(B) Establishment of First cotton mill in Bombay
(C) Bombay getting the status of Presidency city
(D) Migration of large number of people to Bombay from Kutch during famine
- (1) A,C,B,D (2) C,A,B,D
(3) A,D,C,B (4) C,D,B,A
14. Identify the personality who was not associated with the Hindi film industry.
- (1) Harishchandra Sakharan Wadekar
(2) Dadasaheb Phalke
(3) Saadat Hasan Manto
(4) Durgacharan Ray
15. The planned development of Singapore city is compared with which of the following cities?
- (1) Lahore
(2) Leeds
(3) Manchester
(4) Paris
16. The economy of Britain crumbled after the First World War. Identify the factor which did not contribute to the above.
- (1) Strengthening of domestic markets in colonies
(2) Industrialization of China
(3) Stiff competition from US, Germany, Japan
(4) Huge wage structure in colonies
17. Fly Shuttle can speed up which of the following processes in cotton manufacture?
- (1) Carding
(2) Spinning
(3) Weaving
(4) Rolling
18. Exports from which of the following ports to South east Asia fell sharply after the Europeans took control of trading in India?
- (1) Calcutta (2) Madras
(3) Hoogly (4) Surat
19. What was the name given to the paid servant appointed by the East India Company in order to exercise control over the cotton weavers?
- (1) Head jobber
(2) Gomastha
(3) Head weaver
(4) None of these
20. The term 'stapler' is associated with which of the following industries?
- (1) Jute (2) Silk
(3) Cotton (4) Wool
21. Identify the correct chronological order of establishment of cotton mills in the given cities in India.
- (A) Madras
(B) Bombay
(C) Ahmedabad
(D) Kanpur
- (1) CBAD (2) BCDA
(3) BADC (4) CABD
22. Among the following personalities, identify the one who is not an entrepreneur.
- (1) Dinshaw Petit
(2) Dwaraknath Tagore
(3) Jamsetjee Tata
(4) None of these
23. Which of the following developments was not true regarding post World War I economy?
- (1) Manchester recaptured its old position in Indian market
(2) Local industrialists were successful in capturing the home markets
(3) Handicraft production expanded steadily
(4) None of these
24. What was the effect of Russian revolution of 1917 on the working force in London?
- (1) Better housing was provided for London poor
(2) The trade unions were set up and agitated for better conditions of work
(3) Similar kind of rebellion took place in Britain
(4) Many workers were removed from employment
25. Which of the following goods was traded from Bombay port?
- (1) Opium (2) Cotton
(3) Jute (4) Both 1 and 2

ANSWER KEYS**PRACTICE EXERCISE 5 (A)**

1. 2	2. 1	3. 4	4. 3	5. 4	6. 4	7. 3	8. 4	9. 1	10. 2
11. 4	12. 4	13. 4	14. 2	15. 3	16. 3	17. 2	18. 1	19. 4	20. 1
21. 2	22. 4	23. 1	24. 1	25. 1					

PRACTICE EXERCISE 5 (B)

1. 3	2. 4	3. 1	4. 2	5. 4	6. 3	7. 3	8. 1	9. 3	10. 1
11. 3	12. 3	13. 1	14. 4	15. 4	16. 3	17. 3	18. 3	19. 2	20. 1
21. 2	22. 2	23. 1	24. 1	25. 2					

Print Culture and Modern World, Novel, Society and History

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following countries was not associated with the development of earliest kind of print technology?
(1) Korea (2) China
(3) India (4) Japan
2. An epistolary novel *Pamela* written by Richardson is in the form of
(1) serial (2) short stories
(3) letters (4) autobiography
3. The system of hand printing was introduced in which country?
(1) British (2) Korea
(3) Japan (4) China
4. The name 'Diamond Sutra' was associated with which of the following?
(1) First printed Chinese book
(2) First printed Japanese book
(3) First printed Indian book
(4) First printed book on Buddhism
5. The great explorer 'Marco Polo' belonged to which of the following countries?
(1) Italy (2) Cambodia
(3) China (4) Portugal
6. Which of the following countries was associated with the introduction of woodblock printing in Europe?
(1) England (2) Russia
(3) Spain (4) Italy
7. The first printing press was established in which of the following countries?
(1) China (2) Japan
(3) Britain (4) Germany
8. What was the first mechanically printed book in Europe?
(1) Bible (2) *Diamond Sutra*
(3) *Bengal Gazette* (4) *Cotton*
9. Which of the following statements regarding Martin Luther is wrong?
(1) He was one of the main Protestant Reformers
(2) He published theses criticising Roman Catholic Church

- (3) He was the first person associated with publishing of first printed book, *Bible*
 (4) He was the person associated with the publishing of *New Testament of Bible*
10. Name the first Indian language which came in print.
 (1) Hindi (2) Malayalam
 (3) Bengali (4) Konkani
11. English printing in India started with the publication of which of the following?
 (1) *Bible* (2) *Bengal Gazette*
 (3) *Arthashastra* (4) None of these
12. Name the Governor-General who persecuted Hickey for his writings in *Bengal Gazette*.
 (1) Lord Dalhousie (2) Lord Rippon
 (3) Lord Wellesley (4) Lord Warren Hastings
13. Name the publication of Rammohan Roy in 1821.
 (1) *Bengal Gazette* (2) *Samachar Chandrika*
 (3) *Sambad Koumud* (4) All the above
14. Identify the odd one among the following.
 (1) *Jam-i-Jahan Nama*
 (2) *Shamsul Akhbar*
 (3) *Bombay Samachar*
 (4) *Bengal Gazette*
15. Match the entries in column I with those in column II.
- | Column I | Column II |
|----------------------------------|----------------------------|
| a. <i>Rashsundari Debi</i> | i. Kashibaba |
| b. <i>Istri Dharm Vichar</i> | ii. Amar Jiban |
| c. <i>Bengal Gazette</i> | iii. Ramchadda |
| d. <i>Chote Aur Bade Ka Sawa</i> | iv. Gangadhar Bhattacharya |
- (1) a - ii, b - iii, c - iv, d - i
 (2) a - iii, b - iv, c - i, d - ii
 (3) a - ii, b - i, c - iv, d - iii
 (4) a - iii, b - i, c - iv, d - ii
16. Who was the author of the novel, 'Pickwick Papers'?
 (1) Charles Dickens
 (2) William Shakespeare
 (3) Richardson
 (4) George Bernard Shaw
17. What was the significance of Rokeya Hossein's novel 'Sultana's dream'?
 (1) It was based on widow remarriage
 (2) It was based on caste oppression
 (3) It was based on marriage between upper and lower caste people
 (4) It was based on the reversed roles of men and women
18. Identify a novelist who participated in Salt satyagraha.
 (1) Chandu Menon
 (2) Rokeya Hossein
 (3) Vaikkom Muhammad Basheer
 (4) None of these
19. Identify the Kannada novel which highlighted the aspects of child marriage, widow remarriage and women's education.
 (1) *Ponniyin Selvan* (2) *Indulekha*
 (3) *Indirabai* (4) *Padmarag*
20. The main theme of Premchand's famous novel 'Sewasadan' was based on which aspect?
 (1) Adaptation of middle classes to colonised society and preservation of moral values
 (2) Poor condition of women in the society
 (3) Romantic love story with elements of fantasy
 (4) The art and culture of Indian society
21. Which of the following authors translated Charles Dickens's famous novel 'Pickwick Papers' into Indian language?
 (1) Marion Crawford (2) Marie Corelli
 (3) George Eliot (4) Reynolds
22. What was the common feature between the novels 'Henrietta Temple' and 'Vicar of Wakefield'?
 (1) Both the novels were written by same authors.
 (2) Both the novels had the same theme in the stories
 (3) Both the novels were translated into the same language
 (4) Both the novels were translated into the vernacular Indian languages
23. Identify the author of an English novel which was translated into Telugu by Kandukuri Viresalingam.
 (1) Charles Dickens
 (2) Benjamin Disraeli
 (3) Oliver Goldsmith
 (4) R.L.Stevenson
24. What is the common feature between Susan Coolidge and George Eliot?
 (1) Both the authors plotted the stories on the same theme

- (2) The books of these authors were banned as they pointed against Roman Catholic Church
 (3) Both were the pen names of authors
 (4) Both the authors were well-known writers of epistolary novels
25. Which of the following works was done by R. L. Stevenson?
 (1) *Jungle book*
 (2) *Treasure Island*
- (3) *Ramona*
 (4) *Hard Times*
26. What was the main theme of the novel 'Mayor of Casterbridge' written by Thomas Hardy?
 (1) Hardships of industrial workers
 (2) The suppression of women community
 (3) Vanishing traditional rural communities
 (4) Necessity of colonialism

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following statements is true regarding the development of print technology?
 - A. The pioneers of print technology were East Asian countries
 - B. India was associated with the later advancement of print technology
 - C. European countries did not take part in the expansion of print technology
 - D. Indians were pioneers in the art of calligraphy
 - (1) A and B (2) B and C
 - (3) C and D (4) A and C
2. The traditional book of Chinese was called
 - (1) accordion book
 - (2) blue book
 - (3) red book
 - (4) yellow book
3. Buddhist missionaries from China introduced hand print technology in which of the following countries?
 - (1) Japan (2) Russia
 - (3) Britain (4) India
4. Edo is the erstwhile name of which city?
 - (1) Rangoon (2) Tokyo
 - (3) Shanghai (4) Beijing
5. How was woodblock printing introduced in Europe?
 - (1) By British colonial rule in Asian countries
 - (2) Due to wars between Asia and Europe
 - (3) Due to exploration of China by Marco Polo
 - (4) During the First World War
6. Name the great explorer who extensively travelled in China and Mangolia.
 - (1) Vasco-da-gama
 - (2) Christopher Columbus
 - (3) Marco Polo
 - (4) Albuquerque
7. Name the person associated with the establishment of first printing press at Strasbourg?
 - (1) Johann Gutenberg (2) Martin Luther
 - (3) Mennachio (4) Hickey
8. Who is considered as the pioneer of modern Hindi literature?
 - (1) Srinivas Das
 - (2) Premchand
 - (3) Devaki Nandan Khatri
 - (4) Bharatendu Harishchandra
9. Who brought the technology of Printing press to India?
 - (1) Portuguese (2) Dutch
 - (3) French (4) British
10. What was the city associated with the establishment of first Printing Press?
 - (1) Calcutta (2) Goa
 - (3) Bombay (4) Calicut
11. James Augustus Hickey was associated with which of the following?
 - (1) Publishing of first printed book in India
 - (2) Publishing of first printed book in English
 - (3) European who brought the printing press to India
 - (4) None of these

12. After the persecution of Hickey, who started the publication of weekly magazine of *Bengal Gazette*?
 - (1) Rammohan Roy
 - (2) Gangadhar Bhattacharya
 - (3) Tejbahadur
 - (4) Abindranath Tagore
13. Which of the following statements is true regarding the book, 'Samachar Chandrika'?
 - (1) It was a book published in support of social reform movement of Rammohan Roy
 - (2) It was a book published by Hindu orthodoxy in opposition to the ideas of Rammohan Roy
 - (3) It was the first Bengali journal in print and edited by Gangadhar Bhattacharya
 - (4) It was the first daily newspaper published in Indian language
14. In which of the following languages the first full-length autobiography published?
 - (1) Telugu
 - (2) Hindi
 - (3) Marathi
 - (4) Bengali
15. The Governor-General associated with Vernacular Press Act
 - (1) Warren Hastings
 - (2) William Bentinck
 - (3) Lord Rippon
 - (4) Lord Lytton
16. Which of the following was the significance of the novel 'Pickwick Papers'?
 - (1) First printed novel in Europe
 - (2) First novel to be serialised
 - (3) First novel to be printed in printing press
 - (4) First novel to have been banned
17. In what way the novel 'Titash Nadir Naam' different from others?
 - (1) It was the only novel plotted on the aspects of peasants and lower castes.
 - (2) It depicted the community life of fishermen with details of festivals, songs etc.
 - (3) It was written by an author who hailed from a lower-caste fisherfolk community.
 - (4) It was plotted on the aspects of lower caste women community.
18. In what way Saraswativijayam different from Indirabai and Indulekha?
 - (1) The latter were romantic love stories and Saraswativijayam aimed at social reform
 - (2) The latter were based on upper caste society and Saraswativijayam was based on lower caste oppression
 - (3) The latter were written by women novelists while saraswathivijayam was written by male novelist
 - (4) The latter were based on women's problems in society while Saraswativijayam was on caste system.
19. What was the first novel published in Hindi?
 - (1) *Pariksha-Guru*
 - (2) *Chandrakanta*
 - (3) *Sewasadan*
 - (4) *Durgeshnandini*
20. What was bankimchandra Chatopadhyay's first novel in Bengali?
 - (1) *Durgeshnandini*
 - (2) *Priksha-Guru*
 - (3) *Chandrakanta*
 - (4) *Sewasadan*
21. Name the first original literary work written in the novel form in Malayalam.
 - (1) *Pariksha-Guru*
 - (2) *Rajasekhara Charitam*
 - (3) *Indulekha*
 - (4) *Kadambari*
22. Identify the famous earliest literary work which was published much before the advent of novel form of literature.
 - (1) Kadambari
 - (2) Rajasekhara Charitam
 - (3) Panchatantra
 - (4) Both (1) and (3)
23. Another famous work of the author of Oliver Twist was
 - (1) *Great expectations*
 - (2) *Treasure Island*
 - (3) *Jungle Book*
 - (4) *Pride and Prejudice*
24. Which of the following works was based on adventurous and heroic activities of colonisers?
 - (1) What Katy Did
 - (2) Hard Times
 - (3) Pride and Prejudice
 - (4) Jungle Book
25. What is the pen name of Mary Ann Evans?
 - (1) George Eliot
 - (2) Jane Austen
 - (3) Charlotte Bronte
 - (4) Chauncey Woolsey

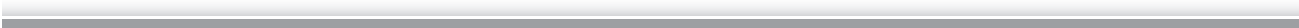
ANSWER KEYS

PRACTICE EXERCISE 6 (A)

1. 3	2. 3	3. 3	4. 2	5. 1	6. 4	7. 4	8. 1	9. 3	10. 4
11. 2	12. 4	13. 3	14. 4	15. 1	16. 1	17. 4	18. 3	19. 3	20. 2
21. 4	22. 4	23. 3	24. 3	25. 2					

PRACTICE EXERCISE 6 (B)

1. 1	2. 2	3. 1	4. 2	5. 3	6. 3	7. 1	8. 4	9. 1	10. 2
11. 1	12. 2	13. 2	14. 4	15. 4	16. 2	17. 3	18. 2	19. 1	20. 1
21. 3	22. 2	23. 1	24. 4	25. 1					



Cultural Heritage of India and Intellectual Awakening

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following statements are wrong regarding Indus valley civilization?
 - A. Indus valley civilization was spread over the regions covering Punjab, Rajasthan, Sind and Gujarat.
 - B Both Mohenjadarro and Harappa of Indus valley civilisztion are now located in India.
 - C. The civilization was believed to have come to an end due to the entry of English East India Company
 - D Indus-valley civilization basically depicted the urban culture.
 - (1) A and D (2) B and C
 - (3) A and B (4) B and D
2. Name the province in which the city of Mohenjadarro of Indus valley civilization was located in British India.
 - (1) Sind province
 - (2) Punjab province
 - (3) North West Frontier province
 - (4) Central province
3. Hindukush mountains do not cover which of the following countries?
 - (1) Nepal (2) Iran
 - (3) Afghanistan (4) Pakistan
4. Before the advent of Aryans, which race dominated India?
 - (1) Mangoloids (2) Negritos
 - (3) Dravidians (4) All of these
5. Identify the false statement regarding the categorization of various dynasties of Indian history.
 - (1) Mourya dynasty comes under ancient history
 - (2) Gupta rule comes under medieval history.
 - (3) Khilji dynasty of Delhi Sultanate comes under medieval history.
 - (4) Delhi Sultanate can be categorized into 5 dynasties.
6. King Ashoka who was known for the construction of monolithic stupas belonged to which dynasty?
 - (1) Gupta dynasty
 - (2) Mourya dynasty
 - (3) Pallava dynasty
 - (4) Pandya dynasty

7. Gandhara art was a blending of which of the following architectures?
 (1) Jainism, Greek (2) Jainism, Buddhism
 (3) Buddhism, Greek (4) None of these
8. Match the entries in column I with those in column II.
- | Column I | Column II |
|-----------------------------------|----------------------|
| a. Mahabalipuram | i. Amaravathi school |
| b. Nataraja temple at Chidambaram | ii. Gandhara school |
| c. Nagarjuna konda | iii. Chola school |
| d. Stone temple at Deogarh | iv. Pallava school |
- (1) a-iii, b-i, c-iv, d-ii
 (2) a-iv, b-i, c-ii, d-iii
 (3) a-iv, b-iii, c-i, d-ii
 (4) a-iii, b-iv, c-ii, d-i
9. Who was the Mughal emperor who laid foundation for the Indo-Persian school of painting?
 (1) Akbar (2) Babur
 (3) Humayun (4) Shahjahan
10. Name the Mughal emperor who gave patronage to mughal miniature paintings.
 (1) Shahjahan (2) Jahangir
 (3) Akbar (4) Humayun
11. What was the significance of Thakshasila during the Vedic period?
 (1) It was capital city
 (2) It was famous religious centre
 (3) Battle of Panipat was held
 (4) It was famous learning centre
12. Which mughal emperor allowed entry of Hindus into madarsas?
 (1) Akbar (2) Shajahan
 (3) Jahangir (4) Humayun
13. What was the most popular school of philosophy among Ashthika Darshanas?
 (1) Nyaya (2) Vedanta
 (3) Sankhya (4) Yoga
14. The famous Astronomer Aryabhatta belonged to which of the following periods?
 (1) Ashoka period (2) Kanishka period
 (3) Harsha period (4) Gupta period
15. Which of the following battles is associated with the establishment of English trade in India?
 (1) Battle of Panipat
 (2) Battle of Plassey
 (3) Battle of Terain
 (4) Battle of Buxar
16. Apart from Abolition of Sati, what other social reform gained support from British government by giving legal binding?
 (1) Female infanticide
 (2) Human sacrifice
 (3) Widow remarriage
 (4) None of these
17. Which of the following reasons could be attributed to the failure of 1857 revolt?
 (1) British had modern war equipment
 (2) Some feudal elements supported British in suppressing the revolt
 (3) The revolt was mostly localised
 (4) All of these
18. What was the major outcome of the Act of 1858 passed by the British Parliament?
 (1) Abolition of office of the Governor General
 (2) Establishment of India Council
 (3) Establishment of Imperial legislative Council
 (4) None of these
19. Mention the years associated with the establishment of East India Company rule in India and the establishment of British rule in India.
 (1) 1757, 1857 (2) 1758, 1858
 (3) 1700, 1800 (4) 1857, 1895
20. Buddhist art and architecture became a part of Indian architecture by which school of art?
 (1) Pallava (2) Amaravathi
 (3) Madhura (4) Gandhara
21. Brihadeswara temple at Tanjore was built by
 (1) Humayum
 (2) Raja Raja Chola
 (3) Rajendra Chola
 (4) Shahjahan
22. Lotus was admirably represented in which school of art?
 (1) Pallava (2) Chola
 (3) Hoyasala (4) Amaravathi

23. Which of the following statements was false regarding Qutub Minar?

- (1) The construction of Qutub Minar was completed by Iltutmish
- (2) It was constructed to commemorate the capture of Delhi by Qutub-ud-din Aibek
- (3) Alai Darwaja was constructed later than Qutub Minar
- (4) None of these

24. Arrange the following events in the chronological order.

- (A) Defeat of Ibrahim Lodi by Babur
 - (B) Defeat of Sirajuddaulah by East India Company
 - (C) Defeat of Prudhviraj Chouhan by Mohammed Ghori
 - (D) Defeat of Mir Quasim by East India Company
- (1) CABD (2) ACBD
 - (3) CADB (4) ACDB

25. Match the entries of Column I with those of Column II.

- | Column I | Column II |
|---------------------------------|---|
| a. Defeat of Sirajuddaulah | i. Establishment of Delhi Sultanate in India |
| b. Defeat of Prudhviraj Chouhan | ii. Establishment of Mughal empire in India |
| c. Defeat of Ibrahim Lodi | iii. Transfer of power from company to crown |
| d. 1857 revolt | iv. Establishment of English East India company rule in India |
- (1) a-iii, b-iv, c-ii, d-i (2) a-iv, b-i, c-ii, d-iii
 - (3) a-iv, b-iii, c-ii, d-i (4) a-iii, b-i, c-iv, d-ii

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Where is the city of Harappa located now?

- (1) Montgomery district of Punjab in India
- (2) Larkana district of Sind in Pakistan
- (3) Montgomery district of Punjab in Pakistan
- (4) Larkana district of Punjab in India

2. Which of the following mountains are associated with the migration of Aryans to India?

- (1) Aravali (2) Vindhya
- (3) Satpura (4) Hindukush

3. Which of the following statements regarding Aryan culture are true?

- (A) Aryans are believed to have Indo-European origin.
 - (B) Aryan civilization was associated with the development of Vedas.
 - (C) Aryan culture basically originated in South India.
 - (D) Dravidian culture was modified form of Aryan civilization.
- (1) A and B (2) A and D
 - (3) B and C (4) B and D

4. Which of the following races of India were believed to have come from the West?

- (1) Astraloids (2) Mongoloids
- (3) Negritosw (4) Dravidians

5. From which territory did Negritos come to India?

- (1) Central Asia (2) Europe
- (3) America (4) Africa

6. Arrange the five dynasties of Delhi Sultanate in chronological order.

- (A) Khilji dynasty (B) Mamluk dynasty
 - (C) Sayyid dynasty (D) Lodi dynasty
 - (E) Tuglaq dynasty
- (1) BACED (2) ACEDB
 - (3) BDCAE (4) ADCEB

7. Which of the following schools of architecture does not belong to South India?

- (1) Amaravathi (2) Chola
- (3) Pallava (4) Madhura

8. Stone temple at Sarnath near Benaras was an architectural form of which period?

- (1) Ashoka period (2) Kanishka period
- (3) Gupta period (4) Chola period

9. The architecture which was developed in South India as contemporary to Sultanate architecture
 - (1) Pallava school of architecture
 - (2) Hoyasala school of architecture
 - (3) Chola school of architecture
 - (4) Amaravathi school of architecture
10. Identify the pair of architectural forms which were built by Akbar.
 - (1) Moti Masjid, Jodhbai's palace
 - (2) Buland Darwaja, Red Fort
 - (3) Moti Masjid, Panchmahal
 - (4) Buland darwaja, Panchmahal
11. Buddhist monastery located at Nalanda is in which of the following states?
 - (1) Haryana
 - (2) Uttar Pradesh
 - (3) Bihar
 - (4) Gujarat
12. Who was appointed as the librarian for the imperial library founded at Delhi during Khilji dynasty?
 - (1) Amir Khusro
 - (2) Birbal
 - (3) Tansen
 - (4) None of these
13. What did Shajahan do to encourage learning and education?
 - (1) By allowing Hindus into madarsas
 - (2) By issuing a regulation to utilize the property of rich people who die without any heir
 - (3) By granting rewards of stipends to students
 - (4) By building colleges at Fatehpur Sikri and Agra
14. Visishtadvaita philosophy was the interpretation of vedanta philosophy by
 - (1) Shankaracharya
 - (2) Ramanujacharya
 - (3) Madhvacharya
 - (4) All the above
15. Varahamihira was an eminent person in the same field as
 - (1) Aryabhatta
 - (2) Panini
 - (3) Koutilya
 - (4) Charaka
16. Apart from Lord William Bentinck, which other Governor general was associated with erradicating the social evils of those times in Indian society?
 - (1) Lord Dalhousie
 - (2) Lord Mounbatten
 - (3) Lord Wellesley
 - (4) William Hardinge
17. Just like Varanasi and Thakshasila in the North, which city was developed as centre of education in the South?
 - (1) Kanchi
 - (2) Rameshwaram
 - (3) Madhurai
 - (4) Calicut
18. The year 1857 in the history of India marked a significant event. Identify that.
 - (1) Last war of feudal elements against British
 - (2) First war of Indian Independence
 - (3) India came under the rule of East India Company
 - (4) Both (1) and (2)
19. Which of the following acts changed the designation of head of the Indian Government from Governor General to Viceroy?
 - (1) Act of 1919
 - (2) Act of 1909
 - (3) Act of 1858
 - (4) Act of 1897
20. Name the mughal emperor who issued a regulation which affected the utilization of properties of rich persons without heir for the maintenance of madarsas.
 - (1) Shajahan
 - (2) Akbar
 - (3) Jahangir
 - (4) Aurangazeb
21. Seven pagodas cut from a great rock boulder is the characteristic feature of which place?
 - (1) Chidambaram
 - (2) Mahabalipuram
 - (3) Tanjore
 - (4) Gangaikonda Cholapuram
22. Name the king associated with the initiation of construction of Qutub Minar.
 - (1) Iltutmish
 - (2) Qutun-ud-din Aibek
 - (3) Ibrahim Lodi
 - (4) Firojsha Tuglaq
23. Alai Darwaja which was the depiction of perfect Islamic architecture was constructed by
 - (1) Qutub-ud-din Aibak
 - (2) Iltutmish
 - (3) Alauddin Khilji
 - (4) Firojsha Tuglaq
24. Identify the battle which did not involve the role of English East India Company.
 - (1) Battle of Plassey
 - (2) Battle of Panipat
 - (3) Battle of Buxar
 - (4) None of these
25. Who among the following scholars was a minister in Chandra Gupta Mourya's court?
 - (1) Koutilya
 - (2) Charaka
 - (3) Panini
 - (4) Aryabhatta

ANSWER KEYS**PRACTICE EXERCISE 7 (A)**

1. 2	2. 1	3. 1	4. 3	5. 2	6. 2	7. 3	8. 3	9. 1	10. 2
11. 4	12. 4	13. 2	14. 4	15. 2	16. 3	17. 4	18. 1	19. 1	20. 4
21. 2	22. 4	23. 4	24. 1	25. 2					

PRACTICE EXERCISE 7 (B)

1. 3	2. 4	3. 1	4. 1	5. 4	6. 1	7. 4	8. 3	9. 2	10. 4
11. 3	12. 1	13. 3	14. 3	15. 1	16. 4	17. 1	18. 4	19. 3	20. 3
21. 2	22. 2	23. 3	24. 2	25. 1					

Forest Society and Colonialism, Pastoralists in the Modern World

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

- What is the purpose of wooden sleepers in railway tracks?
 - To prevent iron tracks from rusting
 - To prevent expansion and contraction of iron tracks
 - To hold the railway tracks together
 - None of these
- Indus valley railway line was between which of the following places?
 - Multan and Sukkur
 - Lahore to Multan
 - Sukkur to Lahore
 - Karachi and Lahore
- The first Inspector General of Forests in India hailed from which of the following countries?
 - Britain
 - France
 - Germany
 - India
- Identify the year in which Indian Forest Act was enacted.
 - 1864
 - 1865
 - 1872
 - 1878
- What were reserved forests according to the Forest Act of 1878?
 - Hunting of wild animals was prohibited there
 - Only one kind of trees were grown there
 - Entry of Villagers into those forests was prohibited
 - Heavy taxes had to be paid for collecting the forest produce
- Which of the following plants could be used by villagers for making ropes?
 - Mahua
 - Bauhinia Vahli
 - Semur
 - Sal
- In which parts of the world shifting cultivation was not in practice?
 - Asia
 - Africa
 - South America
 - North America
- Identify the correct statement regarding the origin of tribal communities of colonial India.
 - Korava, Karacha and Yerukula tribal communities belonged to Madras presidency

- (2) Santhals and oraons had their origin in present Chattisgarh
 (3) Gonds are from present day Jarkhand
 (4) None of these
9. Which of the following colonial powers shared Indonesia's territories?
 (1) Portugal, Dutch
 (2) Dutch, Britain
 (3) France, Dutch
 (4) Britain, Portugal
10. What were the consequences of Bastar rebellion?
 (A) Reserved forests were opened to the tribes permanently.
 (B) Reserved area was reduced to half of that originally planned.
 (C) Reservation in the forests was temporarily suspended.
 (D) Shifting cultivation was resumed.
 (1) A, B, D (2) B, D
 (3) B, C (4) A, D
11. The region of Bastar became controversial even after Indian independence. What was the reason behind the controversy?
 (1) Proposal for construction of dam led to displacement of tribes.
 (2) Proposal for replacing sal trees by pine trees.
 (3) Ban on entry into the forest on tribes living in the surrounding villages.
 (4) Proposal for clearing of that forest for development of SEZ.
12. Name the important pastoral community of Maharashtra.
 (1) Dhangars
 (2) Gujjar Bakarwals
 (3) Gaddis
 (4) Bhotiyas
13. Arrange the following pastoral communities of India in the order of their origin from North to South.
 (A) Banjaras (B) Kurumas
 (C) Gaddis (D) Raikas
 (E) Gujjars
 (1) ECDAB (2) BADCE
 (3) BCADE (4) EDACB
14. What was not the common feature between the pastoral communities of Dhangars and Kurumas? (1) Both belonged to plateau region
 (2) Both communities were blanket weavers
 (3) Both used to migrate to Konkan region during dry season
 (4) Movement of both the communities is based on the alteration of monsoon and dry season
15. Name the colonial countries which drew an international boundary between Kenya and Tanzania.
 (1) Britain, Germany
 (2) France, Germany
 (3) Britain, France
 (4) France, Portugal
16. The present Tanzania was formed by the union of Tanganyika with which of the following territories? following achievements in 1945?
 (1) Zimbabwe (2) Zanzibar
 (3) Nizeria (4) Kenya
17. Which of the following National Parks is located in Kenya?
 (1) Samburu (2) Seringeti
 (3) Elba (4) Kasanka
18. Which of the following crops were included in the crop rotation system in the early 17th century?
 (1) Wheat, coffee
 (2) Rubber, coffee
 (3) Turnip, clover
 (4) Wheat, turnip
19. Building enclosures around common lands affected the British economy in a positive way. Identify the reason.
 (1) Implementation of modern methods of agriculture was made easy
 (2) A systematic crop rotation pattern could increase the productivity
 (3) Reduction of agricultural unemployment
 (4) The reduction in the price of food grains
20. Arrange the following Presidents of USA from its formation after the American War of Independence in the correct chronological order.
 (A) Thomas Jefferson
 (B) Woodrow Wilson
 (C) Franklin D. Roosevelt
 (D) Abraham Lincoln
 (1) ADBC (2) ABCD
 (3) CDAB (4) ACDB

21. Who was the president of USA during the First World War?
 - (1) Woodrow Wilson
 - (2) Thomas Jefferson
 - (3) Lyman Beecher
 - (4) None of these
22. Britain resorted to illegal trade of which of the following commodities with China?
 - (1) Silk
 - (2) Opium
 - (3) Cotton
 - (4) Tea
23. Which of the following statements regarding Opium trading in China was false?
 - (1) Opium trading was confined to medicinal purposes only.
 - (2) Britain resorted to illegal trade of Opium trading in China.
 - (3) After the Opium war, the ban on Opium trading was reimposed.
 - (4) The rulers of China tried to stop the illegal trading of Opium.
24. Which of the following reasons could be attributed to the unwillingness of Indian peasantry to cultivation of Opium?
 - (1) Opium addiction damages health of people.
 - (2) The cultivation of Opium at the existing prices was not profitable for the farmers.
 - (3) The climatic conditions were not suitable for its cultivation in India.
 - (4) None of these
25. Shifting cultivation or Sweden agriculture was called by which names in India?
 - (1) Jhum
 - (2) Podu
 - (3) Bewar
 - (4) All of these

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. How did establishment of railways led to deforestation?
 - (1) Forests had to be cleared to lay railway lines
 - (2) Railway tracks required wooden sleepers
 - (3) Running of locomotives required huge quantity of wood as fuel
 - (4) All of these
2. Northern State railway line laid during British rule was between which of the following places?
 - (1) Multan and Sukkur
 - (2) Lahore to Multan
 - (3) Sukkur to Lahore
 - (4) Lahore to Delhi
3. The Indian Forest Service was set up in which year?
 - (1) 1864
 - (2) 1865
 - (3) 1878
 - (4) 1906
4. Where was Imperial Forest Research Institute established?
 - (1) Lucknow
 - (2) Srinagar
 - (3) Delhi
 - (4) Dehradun
5. First amendment of Forest Act in 1878 introduced which of the following changes?
 - (1) Categorization of forests into three types
 - (2) Clearing of forests followed by reclamation
 - (3) Plantation of only one type of trees
 - (4) Plantation of only trees which give timber
6. For what purpose Mahua tree was used by villagers?
 - (1) Grating vegetables
 - (2) Making ropes
 - (3) Oil for lighting lamps
 - (4) Fuel wood
7. In which of the following countries shifting cultivation was not prominent?
 - (1) China
 - (2) Egypt
 - (3) Germany
 - (4) Brazil
8. What was common about Siddu and Kanu in Santhal paraganas and Birsa Munda of Chotanagpur?
 - (1) They were the names of tribal communities associated with those regions
 - (2) They were the tribes who were involved in shifting cultivation
 - (3) They were the people associated with the tribal rebellions
 - (4) All of these

9. What reasons can be attributed to the ban imposed on shifting cultivation in India by British?
 - (A) Fear of forest fires
 - (B) Difficulty in framing land tax structure
 - (C) Loss of soil fertility due to burning
 - (D) Wastage of agricultural land when left fallow
 - (1) A and B
 - (2) B and C
 - (3) A and C
 - (4) B and D
10. Major part of Indonesia was under the rule of which of the following colonial powers?
 - (1) Portugal
 - (2) Dutch
 - (3) France
 - (4) Britain
11. Name the island in Indonesia which is the largest producer of rice.
 - (1) Malaya
 - (2) Java
 - (3) Sumatra
 - (4) Borneo
12. Name the pastoral community which followed seasonal movement similar to Gujjar Bakarwals.
 - (1) Dhangars
 - (2) Gollas
 - (3) Gaddis
 - (4) All of these
13. Which of the following statements is false regarding pastoral communities in India?
 - (1) All the pastoral communities of India followed cold and summer seasonal cycle of shifting.
 - (2) Raikas are the tribal community of Rajasthan Bakarw.
 - (3) Gharwals are exclusively a pastoral tribe rearing goat and sheep.
 - (4) Dhangar community of pastoralists are welcomed by Konkani peasants.
14. The east African countries of Tanzania and Kenya are inhabited by which of the following communities?
 - (1) Somali
 - (2) Berbers
 - (3) Turkana
 - (4) Maasai
15. Which of the following reasons can be attributed to drastic reduction in pasturelands of Maasi community in the colonial period?
 - (1) Conversion of large areas into National Parks
 - (2) Conversion of pasturelands into cultivated fields
 - (3) Sharing of African countries by European colonial powers
 - (4) All of these
16. Serengeti National Park is located in which of the following territories of Africa?
 - (1) Kenya
 - (2) Zimbabwe
 - (3) Ethiopia
 - (4) Tanzania
17. According to the England peasantry, growing of turnip had the following benefits for the farmer?
 - (1) Increases the nitrogen content of the soil
 - (2) It can serve as a fodder crop for cattle
 - (3) It increases the phosphorous content in the soil
 - (4) Both (1) and (2)
18. At the end of 18th century, import of food grains to England was disrupted due to which of the following reasons?
 - (1) England was involved in war with France.
 - (2) Heavy duties were imposed by the British parliament on imported commodities.
 - (3) The food grain production was excess and the demand fell.
 - (4) All the above
19. Identify the period of American war of Independence.
 - (1) 1775–1783
 - (2) 1785–1793
 - (3) 1765–1773
 - (4) 1793–1809
20. Which of the following was the consequence of American War of Independence?
 - (1) Separation of South America and North America
 - (2) Splitting of different states from USA
 - (3) Formation of USA
 - (4) Establishment of democratic Government in North and South America
21. What was the problem faced by the American farmers for wheat cultivation when they moved from Great plains to eastern coastal areas?
 - (1) The soil was not fertile
 - (2) Labour were not available sufficiently
 - (3) The climate was not suitable for the cultivation of wheat
 - (4) The land was covered with deep rooted grass
22. Which country introduced Opium to China?
 - (1) Dutch
 - (2) England
 - (3) Portugal
 - (4) France

23. What was the purpose behind the trading of Opium by British in China?

 - (1) China's condition to exchange China's tea with Opium.
 - (2) Britain wanted to get tea from China without taxing its bullion reserves.
 - (3) Britain wanted to use this as a first step towards colonising China.
 - (4) None of these

24. Which of the following statements regarding the cultivation of Opium in India is false?
- (1) Cultivation of Opium can be carried out in barren land.
 - (2) Cultivation of Opium requires lot of nurturing.
 - (3) British offered very low prices for Opium in India.
 - (4) None of these

25. Name the most cultivated crop in Brazil and also the product of it.

 - (1) Manioc, cotton (2) Manioc, rubber
 - (3) Mahua, oilseeds (4) Mahua, rubber

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 3 | 4. 2 | 5. 3 | 6. 2 | 7. 4 | 8. 1 | 9. 2 | 10. 2 |
| 11. 1 | 12. 1 | 13. 1 | 14. 3 | 15. 1 | 16. 2 | 17. 1 | 18. 3 | 19. 2 | 20. 1 |
| 21. 2 | 22. 2 | 23. 3 | 24. 2 | 25. 4 | | | | | |

PRACTICE EXERCISE 8 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 1 | 4. 4 | 5. 1 | 6. 3 | 7. 3 | 8. 3 | 9. 1 | 10. 2 |
| 11. 2 | 12. 3 | 13. 1 | 14. 4 | 15. 4 | 16. 4 | 17. 4 | 18. 1 | 19. 2 | 20. 3 |
| 21. 4 | 22. 3 | 23. 2 | 24. 1 | 25. 4 | | | | | |

World Up to and After the World War-II

PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 20: Select the correct alternative from the given choices.

1. What was the immediate cause for World War I?
 - (1) Sarajevo crisis
 - (2) Pan Slave movement in Balkan states
 - (3) Franco-Prussian war
 - (4) Austrian occupation of Bosnia and Herzegovina
2. What was the motive behind England entering into the war by declaring war on Germany?
 - (1) Attack of Germany on Belgium
 - (2) England's support to Serbia
 - (3) Attack of Germany on Austria
 - (4) Anglo-French alliance
3. Which of the following events during the World War I appeared to turn the war in favour of Central powers?
 - (1) Entry of USA into the war
 - (2) Withdrawal of Russia from the war
 - (3) Withdrawal of Austria-Hungary from the war
 - (4) Armistice signed by Germany in favour of western front
4. Which of the following countries were formed as a result of Paris peace conference?
 - (1) Poland
 - (2) Czechoslovakia
 - (3) Yugoslavia
 - (4) All of these
5. The lower House of German Parliament was called
 - (1) Shougunate
 - (2) Senate
 - (3) Diet
 - (4) Reichstag
6. Treaty of Shimonosheki was a peace treaty between which countries?
 - (1) Japan and China
 - (2) China and Russia
 - (3) Japan and Korea
 - (4) China and Korea
7. Identify the American base which was subjected to bombing by Japan.
 - (1) Houston
 - (2) Pearl Harbour
 - (3) Pittsburg
 - (4) Texas
8. Which of the following were the correct territorial agreements of Treaty of Versailles?
 - (A) France regained Alsace-Lorraine from Germany.
 - (B) England regained the areas of Eupen and Malmedy.

- (C) Loss of Schelswigh to Denmark
(D) Loss of a portion of west Prussia to France
(1) A,B (2) A,C
(3) B,C (4) B,D
9. Which territory was occupied by Italy against the terms of League of Nations?
(1) Manchuria (2) Poland
(3) Abyssinia (4) Spain
10. Arrange the following events of World War I in chronological order.
(A) France declared war on Germany
(B) Austria declared war on Serbia
(C) Germany declared war on Russia
(D) Russia declared war on Austria
(1) B,D,C,A (2) C,A,B,D
(3) A,D,C,B (4) B,C,D,A
11. Identify a pair of European countries which stayed away from the Marshall plan.
(1) Poland, Spain
(2) Bulgaria, Sweden
(3) Holland, Yugoslavia
(4) Hungary, Finland
12. What was the main motive behind America's proposal of Marshall Plan and later its support for its success?
(1) Strengthening of economies of European countries after World War II.
(2) Promoting World Peace.
(3) Compensation of loss caused by it due to the usage of Atom bomb.
(4) Protecting spreading of communism in European countries.
13. Who was the main architect of League of Nations?
(1) Stalin (2) Winston Churchill
(3) Woodrow Wilson (4) Mustafa Kemal
14. Name the country which completely remained aloof from the League of Nations.
(1) Russia (2) USA
(3) Italy (4) Germany
15. Which of the following aggressions does not come under violation of principles of League of Nations by its member countries?
(1) Germany's attack on Austria
(2) Germany's attack on Poland
(3) Japan's attack on China
(4) None of these
16. Treaty of Tienstin was associated with which of the following countries?
(1) Japan (2) China
(3) Indonesia (4) Korea
17. What was the reason for the rivalry of France with Germany much before the World War I?
(1) Controversy over Balkan states
(2) Loss of Alsace Lorraine in Franco-Prussian War
(3) Controversy over Sudetanland
(4) Controversy over Danzig corridor
18. Triple alliance was formed by the joining of which country later?
(1) Germany (2) France
(3) England (4) Italy
19. Identify the group of countries which formed an alliance group called 'Triple Entente'.
(1) Germany, Austria-Hungary, Italy
(2) England, Russia, France
(3) Germany, Russia, Austria-Hungary
(4) France, Italy, Russia
20. Headquarters of League of Nations was established at which place?
(1) New York (2) Berlin
(3) Geneva (4) Paris

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 20: Select the correct alternative from the given choices.

1. Which of the following statements are not true regarding the countries of Bosnia, Serbia Rumania Albania and Montenegro?
- A. They were together called Balkan States
B. They were under Russian rule
C. They were all associated with the Pan-Slave movement
D. Austria supported the Balkan movement against Turkey

- (1) A and D (2) A and B
(3) B and D (4) B and C
2. What was the common feature among the countries of Holland, Switzerland and Spain in the context of World War I?
- (1) They all extended support to Triple alliance.
(2) They all extended support to Triple Entente.
(3) They all entered the war after the entry of US into the war.
(4) They were all out of the war.
3. Which of the following facts about Lenin was wrong?
- (1) Lenin became Prime Minister of Russia by replacing Czar Nicholas II
(2) Lenin spent few years in exile in Siberia
(3) He first joined Socialist Democratic Party
(4) Lenin was the founder of Bolshevik Party
4. Why was Mussolini sent to jail and exiled to Switzerland?
- (1) He attempted to popularize the ideas of socialism.
(2) He started a newspaper "Il Papalo 'd' Italia.
(3) He advocated anti communist ideas.
(4) He opposed the aggressive war of Italy on Turkey.
5. With which of the following events the place Rhineland associated?
- (1) It was given back to Germany by the allies on Hitler's persuasion.
(2) It was occupied by Hitler in violation of Treaty of Versailles.
(3) It was occupied by Mussolini in violation of Treaty of Versailles.
(4) It was the place where the Austrian prince was assassinated by Serb.
6. What was the criticism of American Senate against Treaty of Versailles?
- (1) England reaped most benefits of war
(2) The terms imposed on Germany were not harsh enough
(3) America was not benefited by the new territorial agreements
(4) France reaped most benefits of war
7. Identify the historic development which Mustafa Kemal was associated with.
- (1) Participation of Turkey in World War II
(2) Taking Balkan States into the control of Turkey
(3) Making Turkey a Republic
(4) Lending military support to Sultan of Turkey
8. Name the big European powers which were involved in internal Civil War in Spain.
- (1) Britain and France
(2) Germany and France
(3) Germany and Italy
(4) Britain and Germany
9. Which of the following was the immediate cause of World War II?
- (1) Invasion of Manchuria by Japan
(2) Occupation of Abyssinia by Italy
(3) Germany's attack on Austria
(4) Germany's attack on Poland
10. What was the demand of Hitler to Poland which led to a war between the two countries?
- (1) Unification of Poland with Germany
(2) Annexation of Danzig Corridor to Germany
(3) Abolition of Communist regime in Poland
(4) Provision of corridor to Germany through Poland
11. What was the main objective of Marshall Plan?
- (1) Making of peace treaties among European Nations
(2) Economic reconstruction of Europe
(3) New territorial rearrangements in Europe
(4) Protesting against communist regimes in Europe
12. Which of the territorial aggressions of member countries could not be prevented by League of Nations?
- (1) Japan's invasion of Manchuria
(2) Germany's attack on Austria
(3) Italy's occupation of Abyssinia
(4) All the above
13. Which countries resigned the membership of League of Nations?
- (1) Russia (2) USA
(3) Japan (4) All the above
14. Why could USA not take membership of League of Nations?
- (1) League did not accept to give exclusive veto power to USA
(2) America was against Russia's membership in the League of Nations

- (3) Democrats opposed it in the American Senate
(4) Republicans opposed it in the American Senate
15. Name the explorer who first explored Africa.
(1) Cameroon (2) Ferdinand Magellan
(3) Fahian (4) Livingston
16. Identify the correct chronological order of events of World War II.
(A) Attack of USA on Japan
(B) Attack of Germany on England
(C) Attack of Germany on Poland
(D) Bombing on Pearl Harbour
(1) CBDA (2) BCDA
(3) BADC (4) CABD
17. Before the formation of 'triple alliance', which countries formed the dual alliance?
(1) Germany and Austria-Hungary
(2) France and Austria-Hungary
(3) England and France
(4) Germany and France
18. Which of the following developments was not true regarding the consequences of post World War II?
- (1) Splitting of world into two power blocks
(2) Reduced supremacy of European countries over Asia
(3) Carving of new countries in Europe
(4) Independence to Burma and Ceylon in Asia
19. Match the entries in column I with those in Column II and identify the correct choice.
- | Column I | Column II |
|-----------------------|-------------------------------------|
| A. Boltshevik Party | i. Russian Revolution |
| B. Nazi Party | ii. Unification of Italy |
| C. Franco | iii. Unification of Germany |
| D. Pan-Slave movement | iv. Formation of Republic of Turkey |
| (1) A | (2) B |
| (3) C | (4) D |
20. Boundary demarcation disputes between which of the following countries were successfully settled by the League of Nations?
(1) Germany and Poland
(2) Greece and Bulgaria
(3) Japan and Korea
(4) Both (1) and (2)

ANSWER KEYS

PRACTICE EXERCISE 9 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 1 | 4. 4 | 5. 4 | 6. 1 | 7. 2 | 8. 2 | 9. 3 | 10. 1 |
| 11. 4 | 12. 3 | 13. 2 | 14. 2 | 15. 2 | 16. 2 | 17. 4 | 18. 2 | 19. 2 | 20. 3 |

PRACTICE EXERCISE 9 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 1 | 4. 4 | 5. 2 | 6. 1 | 7. 3 | 8. 3 | 9. 4 | 10. 2 |
| 11. 2 | 12. 4 | 13. 1 | 14. 4 | 15. 4 | 16. 1 | 17. 1 | 18. 3 | 19. 1 | 20. 4 |

Medieval and Modern World

PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following invasions in India led to the disintegration of Gupta Empire?
(1) Chinese invasion
(2) Arab invasion
(3) Huna invasion
(4) Turkish invasion
2. What is the present name of the city of Constantinople?
(1) Rome
(2) Istanbul
(3) Benzanine
(4) Same
3. Name the emperor who built the famous St Sophia's Church in Byzantine empire.
(1) Justinian
(2) Bizantine
(3) Constantine
(4) None of these
4. Which of the following invasions resulted in the downfall of Roman empire?
(1) German invasion
(2) Greek invasion
(3) Arab invasion
(4) Turkish invasion
5. Which country of western Europe broke out into pieces during the period of Holy Roman empire in eastern Europe?
(1) Italy
(2) Germany
(3) France
(4) Ireland
6. The beginning of Mohammadan era is called by what name?
(1) Jihad
(2) Zakat
(3) Huz
(4) Hizra
7. People from which Muslim country invaded India first?
(1) Arabia
(2) Turkey
(3) Iran
(4) Iraq
8. After the downfall of Gupta dynasty and before the invasion by Arabs, which dynasty trained in vain to bring political unity in North India?
(1) Mourya dynasty
(2) Mughal dynasty
(3) Pushyabhuti dynasty
(4) Hoyasala dynasty

9. Which of the following Muslim rulers is well known for making as many as 17 invasions on Northern India?
 (1) Mahmood Ghazni (2) Mahmood Gori
 (3) Qutubuddin Aibak (4) Babur
10. Who among the following was a blind poet?
 (1) Kabirdas (2) Surdas
 (3) Tulsidas (4) Ramdas
11. Imperial gardens was built by which Mughal ruler?
 (1) Akbar (2) Shajahan
 (3) Jahangir (4) Humayun
12. What was not the common feature between China and Japan during medieval period?
 (1) Authoritarian Government of Kings
 (2) Influence of Buddhism
 (3) Importance to navigation
 (4) Extensive powers to land lords
13. Under which of the following dynasties, Manchuria and Turkistan were annexed to China?
 (1) Han dynasty (2) Hsui dynasty
 (3) Tung dynasty (4) Manchu dynasty
14. Name the dynasty in China associated with the introduction of paper currency for the first time in the world.
 (1) Ming dynasty (2) Manchu dynasty
 (3) Tung dynasty (4) Sung dynasty
15. Which of the following historic events was considered as the basic cause for "Renaissance" in Europe?
 (1) Fall of Constantinople to Turks
 (2) Marco Polo's expedition to China
 (3) Establishment of trade relations with Asian countries
 (4) None of these
16. Name the explorer actually reached the continent and named it as America.
 (1) Amerigo Vispucci (2) Columbus
 (3) Vasco-da-gama (4) Marco-Polo
17. Identify the country which explored the continent of Latin America.
 (1) Portugal (2) Spain
 (3) Italy (4) Germany
18. Name the explorer who during his expedition through an ocean named it as Pacific ocean due to its calmness.
 (1) Christopher Columbus
 (2) Vasco-da-gama
 (3) Ferdinand Magellan
 (4) Fahian
19. The creator of the world famous painting 'Monalisa' also created which of the following artistic works?
 (1) The Last Supper (2) The Last Judgement
 (3) The Fall of Man (4) All of these
20. Who was the first European who proposed the theory that the earth is a small planet revolving around the Sun?
 (1) Francis Bacon (2) Aristotle
 (3) Copernicus (4) Galileo
21. Match the entries of column I with those in column II.
- | Column I | Column II |
|-------------|-------------------------|
| a. Ptolemy | i. Blood circulation |
| b. Newton | ii. Human anatomy |
| c. Harvey | iii. Opposed Copernicus |
| d. Vesuvias | iv. Telescope |
| e. Galelio | v. Gravitational force |
- (1) a - iii, b - v, c - i, d - ii, e - iv
 (2) a - iii, b - v, c - ii, d - i, e - iv
 (3) a - ii, b - v, c - i, d - iii, e - iv
 (4) a - ii, b - iii, c - iv, d - v, e - iv
22. Find the odd one from among the following.
 (1) Puritans (2) Huguenots
 (3) Presbyterians (4) Catholics
23. Which country got the credit for the invention of Mariner's Compass?
 (1) Italy (2) England
 (3) America (4) China
24. During whose vice-royalty, the first railway line was laid in India?
 (1) William Bentinck
 (2) Mount Batten
 (3) Lord Dalhousie
 (4) Lord Rippon
25. The word 'Shintoism' is related to which of the following?
 (1) Worshipping the dead in Japan
 (2) Buddhist method of worshipping in Japan
 (3) Method of agriculture followed in Japan
 (4) Method of fishing followed in Japan

PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. What was the erstwhile name of the city of Constantinople which was the capital of Eastern Roman?
 - (1) Byzantine (2) Rome
 - (3) Istanbul (4) None of these
2. Which of the following territories was not part of the Byzantine Empire?
 - (1) Egypt (2) Syria
 - (3) Cyprus (4) Palestine
3. Which of the following statements is false regarding Byzantine empire?
 - (1) St Sophia's church was the famous symbol of Byzantine architecture
 - (2) Constantine was the last emperor of Byzantine Empire
 - (3) Byzantine empire was invaded by Ottoman Turks
 - (4) Byzantine architecture was a blend of Greek and Roman architectures
4. Holy Roman empire was established by the union of which countries?
 - (1) Germany and Poland
 - (2) Poland and Italy
 - (3) Germany and Austria
 - (4) Austria and Hungary
5. With which of the following events was the place Madina associated?
 - (1) Birth place of Prophet Mohammad
 - (2) The death place of Prophet mohammad
 - (3) The place to which Prophet mohammad migrated
 - (4) The place where Mohammad became Prophet
6. What is 'Jehad' according to the tenets of Islam?
 - (1) Pilgrimage of Muslims to Mecca
 - (2) Muslims' fight against bad to achieve good
 - (3) A form of worshipping God
 - (4) Giving alms to poor
7. What was meant by 'Crusades'?
 - (1) Wars by Muslims to conquer the holy places of Christians
 - (2) Wars made by christians against Muslims to reconquer their holy places
 - (3) Wars made by Christians to invade Muslim countries
 - (4) Both (1) and (2)
8. What were the consequences of Bastar rebellion?
 - (A) Reserved forests were opened to the tribes permanently
 - (B) Reserved area was reduced to half of that originally planned
 - (C) Reservation in the forests was temporarily suspended
 - (D) Shifting cultivation was resumed
 - (1) A, B, D (2) B, D
 - (3) B, C (4) A, D
9. Arrange the following events of Indian History of medieval times in correct chronological order
 - (A) Defeat of Ibrahim Lodi
 - (B) Establishment of Turkish dynasty
 - (C) Attack of Mahmood Ghori on Mohamood Ghazni
 - (D) Proclamation of Qutub-ud-din Aibak as Sultan
 - (E) Conquering of Sindh by Arabian invasion
 - (1) EBCDA
 - (2) EDCBA
 - (3) BCDEA
 - (4) BDCEA
10. Name the poet who was known as second Valmiki.
 - (1) Tulsidas (2) Kabirdas
 - (3) Surdas (4) Ramdas
11. Which of the following statements is false regarding Chinese trade and commerce during middle ages?
 - (1) Rice and wheat were the major crops grown in China in those times
 - (2) China had trade relations with India
 - (3) Paper was one of the major export products of China
 - (4) Huien Tsang was a Chinese explorer
12. Which territory was annexed to China during the reign of 'Hsui' dynasty?
 - (1) Manchuria (2) Peking
 - (3) Mangolia (4) Farmosa

13. After the invasion of China by Mangols, which dynasty came into power?
 (1) Manchu dynasty (2) Sung dynasty
 (3) Tung dynasty (4) Ming dynasty
14. What was the major occupation of Japanese in medieval period?
 (1) Agriculture
 (2) Fishing
 (3) Mining
 (4) Trading
15. Which of the following was false regarding West Indies?
 (1) These islands were discovered by Columbus
 (2) They are located in Atlantic ocean
 (3) They belonged to India during medieval history
 (4) None of these
16. Which of the following literary works were based on criticism against the abusive church practices?
 (1) *Divine Comedy, Utopia*
 (2) *Utopia, In Praise of Folly*
 (3) *Divine Comedy, In Praise of Folly*
 (4) *Donquixote, Utopia*
17. Arrange the following geographical expeditions by different explorers in the correct chronological order.
 (A) Expedition to Latin America
 (B) Expedition to India
 (C) Expedition to Cape of Good Hope
 (D) Expedition to North America
 (1) CBDA
 (2) DABC
 (3) CABD
 (4) DCBA
18. Name the explorer who sailed round the world along with his country.
 (1) Ferdinand Magilan, Portugal
 (2) Francis Drake, England
 (3) John Cobot, England
 (4) Columbus, Italy
19. Who was the author of the book 'Utopia' which depicted the life of an ideal man?
 (1) William Shakespear
 (2) Thomas Moor
 (3) Francis Bacon
 (4) Cervantes
20. Which of the following statements regarding Opium trading in China was false?
 (1) Opium trading was confined to medicinal purposes only
 (2) Britain resorted to illegal trade of Opium trading in China
 (3) After the Opium war, the ban on Opium trading was reimposed
 (4) The rulers of China tried to stop the illegal trading of Opium
21. Match the entries of Column I with those in Column II.
- | Column I | Column II |
|------------------------------|----------------------|
| a. <i>In Praise of Folly</i> | i. Thomas Moor |
| b. <i>Utopia</i> | ii. Cervantes |
| c. <i>Donquixote</i> | iii. Erasmus |
| d. <i>Madona</i> | iv. Leonardo Davinci |
| e. <i>The last Judgement</i> | v. Rapheal |
- (1) a - ii, b - iv, c - i, d - v, e - iii
 (2) a - iii, b - i, c - ii, d - v, e - v
 (3) a - ii, b - iii, c - iv, d - v, e - i
 (4) a - iii, b - v, c - ii, d - i, e - iv
22. The organization 'Soldiers of Jesus' started by Ignatius Loyola was associated with which of the following?
 (1) Protestant reformation
 (2) Support for Orthodox Catholic practices
 (3) Catholic counter reformation
 (4) None of these
23. Which of the following scientists developed something which was a forerunner to the present day Rail engine?
 (1) James Watt (2) George Stevenson
 (3) James Hargreaves (4) Richard Ark Wright
24. The term 'Mule' was associated with which of the following?
 (1) Separation of cotton and seeds from raw cotton
 (2) Combination of Spinning Jenney and water frame
 (3) A machine which improved weaving
 (4) Simple Spinning Jenney
25. Japanese economy was not mainly based on agriculture. What was the reason?
 (1) The climate was not suitable for cultivation
 (2) The land was completely barren
 (3) The group of islands had very less proportion of cultivable land
 (4) All of these

ANSWER KEYS**PRACTICE EXERCISE 10 (A)**

1. 2	2. 1	3. 4	4. 3	5. 4	6. 4	7. 3	8. 4	9. 1	10. 2
11. 4	12. 4	13. 4	14. 2	15. 3	16. 3	17. 2	18. 1	19. 4	20. 1
21. 2	22. 4	23. 1	24. 1	25. 1					

PRACTICE EXERCISE 10 (B)

1. 3	2. 4	3. 1	4. 2	5. 4	6. 3	7. 3	8. 1	9. 3	10. 1
11. 3	12. 3	13. 1	14. 4	15. 4	16. 3	17. 3	18. 3	19. 2	20. 1
21. 2	22. 2	23. 1	24. 1	25. 2					

Early Iron Age Societies

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

- Which of the following ages is associated with the life of man as food gatherer?
 - Palaeolithic age
 - Neolithic age
 - Mesolithic age
 - Chalcolithic age
- Which age was associated with the origin of fire?
 - Mesolithic age
 - Chalcolithic age
 - Paleolithic age
 - Neolithic age
- Which of the following ages was associated with the beginning of agriculture and cattle rearing?
 - Neolithic age
 - Mesolithic age
 - Chalcolithic age
 - Bronge age
- Which of the following river valleys was associated with Mesopotamian civilization?
 - Tigris
 - Euphrates
 - Nile
 - Both (1) and (2)
- Which of the following countries had Republican form of Government in ancient Iron age itself?

- China
 - Japan
 - America
 - Greece
- Arrange the five evolutionary stages of man in chronological order.
 - Neanderthal man
 - Homo Erectus
 - Homo Sapiens
 - Astro Pythicus
 - Rama Pythicus
 - DEBAC
 - EDABC
 - EDBAC
 - ADCEB
- In which dynastic rule was 'The Great Wall of China' built?
 - Hang dynasty
 - Tang dynasty
 - Ching dynasty
 - Ming dynasty
 - What was the first strong dynasty which ruled North India?
 - Magadha dynasty
 - Gupta dynasty
 - Mourya dynasty
 - Pushyabhuti dynasty

9. Match the entries in column I with those in column II.
- | Column I | Column II |
|----------------|-------------------------------------|
| a. Euclidi | i. Distance between earth and moon |
| b. Hippocrates | ii. Earth at the centre of universe |
| c. Hipparcus | iii. Father of Geometry |
| d. Ptolemy | iv. Father of modern medicine |
- (1) a-iii, b-i, c-iv, d-ii (2) a-iv, b-i, c-ii, d-iii
(3) a-iv, b-iii, c-i, d-ii (4) a-iii, b-iv, c-i, d-ii
10. Name the first dynasty established in Iran.
(1) Sassanid dynasty (2) Byzantine dynasty
(3) Hun dynasty (4) Akaneveid dynasty
11. The Parsees in India belonged to which religious cult?
(1) Christianity (2) Judaism
(3) Zoroastrianism (4) None of these
12. What was the capital of Persian Empire which represented the cultural heritage of Persia?
(1) Persipolis (2) Tehrain
(3) Baghdad (4) Babylon
13. Identify the false statement regarding Zoroastrianism.
(1) Zoroastrianism practiced Polytheism
(2) Zoroastrianism followed Christianity
(3) Zendavastha was the religious book of Zoroastrians
(4) None of these
14. Identify the statement which was not a feature of Greek Civilization.
(1) Ancient Greeks worshipped Zeus, the Sky God
(2) Illiad and Odyssey were master pieces of Greek literature
(3) The games played in the worship of God Athens took the form of Modern Olympics
(4) Greeks used a musical instrument called 'lyre' in the Ancient times
15. The city of Rome was built on the banks of which river?
(1) Tresa (2) Tiber
(3) Lyo (4) Trose
16. Which language was the basis for most of the today's scientific terminology?
(1) Greek (2) English
(3) Latin (4) Persian
17. Name the country associated with the origin of Christianity.
(1) Palestine (2) Italy
(3) Ireland (4) Babylon
18. What is the basic ideological difference between Jews and Christians?
(1) Jews believe in polytheism
(2) Belief in Jesus Christ as Messiah by Christians
(3) Jews believe only Yehova as God and does not believe any Messiah
(4) Both (1) and (2)
19. Which region of Africa was famous for perfumes?
(1) Somalia (2) Ethiopia
(3) Egypt (4) All of these
20. Ball play was a kind of religious worship according to which civilization in American continent?
(1) Maya (2) Aztecs
(3) Inkes (4) Kish
21. What was the name given to the people of Aztec civilization?
(1) Tenkos (2) Dellas
(3) Souhalts (4) Mexicans
22. The then capital city of Inkes civilization is called by which name now?
(1) Chile (2) Peru
(3) Mexico (4) Detroit
23. In which of the following Greek states, a republican form of government existed in Iron age itself?
(1) Athens (2) Sparta
(3) Corinth (4) Thebes
24. Who among the following used concrete for constructions for the first time?
(1) Romans
(2) Persians
(3) Greeks
(4) Americans
25. Which European country was known to have looted the wealth of American continent which marked the end of Inkes civilization?
(1) Portugal (2) Italy
(3) Spain (4) England

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Identify the incorrect statements among the following.
 - A. Mesopotamian and Harappan civilizations were supposed to be the contemporary civilizations.
 - B. Anthropology is the study of people and their way of life in the ancient period.
 - C. Excavations of pyramids in Egypt provided proof for the Indus valley civilization.
 - D. All the civilizations flourished in river valleys.
 - (1) A and D (2) B and C
 - (3) A and B (4) B and D
2. Cro magnons is another name for which of the following man?
 - (1) Astro Pythicus
 - (2) Homoeructus
 - (3) Neanderthal man
 - (4) Homo Sapiens
3. Which of the following features was not the feature of Neolithic age?
 - (A) Baking of clay pots started in this age.
 - (B) Man was merely a food gatherer.
 - (C) The age was associated with the origin of usage of fire.
 - (D) The age marked the beginning of art of weaving.
 - (1) A and B (2) A and D
 - (3) B and C (4) B and D
4. The place 'Sumeria' was a part of which civilization?
 - (1) Mesopotamian civilization
 - (2) Nile valley civilization
 - (3) Harappan civilization
 - (4) Ancient chinese civilization
5. Identify the false statement regarding Mouryan dynasty in India.
 - (1) Mourya dynasty had the capital at Magadha
 - (2) Ashoka was the first emperor in Mouryan dynasty.
 - (3) Busshiam entered India during the rule of Mouryan dynasty
 - (4) None of these
6. Name the Ancient Chinese civilization that flourished in Bronge age.
 - (1) Hang civilization
 - (2) Shang civilization
 - (3) Ching civilization
 - (4) Tsang civilization
7. Who among the following was considered to be the contemporary of Mahavira and Gautam Buddha?
 - (1) Ashoka (2) Lao Tze
 - (3) Tsang Tsue (4) Confucius
8. Which civilization was associated with the development of first calendar?
 - (1) Egyptian civilization
 - (2) Shing civilization
 - (3) Mesopotamian civilization
 - (4) Harappan civilization
9. In which country was the system of appointment of Government servants by competitive examinations introduced?
 - (1) China (2) Japan
 - (3) England (4) America
10. What was the erstwhile name of Iran?
 - (1) Arabia (2) Iraq
 - (3) Babylon (4) Persia
11. Which of the following territories was not a part of Persian empire?
 - (1) Egypt (2) Saudi Arabia
 - (3) Iran (4) Turkey
12. Epicuranism and Stoicism were associated with which philosophy?
 - (1) Greek (2) Persian
 - (3) Chinese (4) Roman
13. Alexander the Great could not achieve success in his attacks against which of the following territories?
 - (1) Asia Minor (2) Egypt
 - (3) India (4) Sardinia
14. Italian peninsula was in which of the following water bodies?
 - (1) Atlantic ocean (2) Adriatic sea
 - (3) Pacific ocean (4) Mediterranean sea

15. Which system of Romans was adopted by many countries?
 (1) Electoral system (2) Education system
 (3) Legal system (4) Administrative system
16. In what way are the present day calendars related to ancient Romans?
 (1) The system of calendars was first developed by Romans
 (2) Roman numerals are used in the calendars
 (3) Romans used the present day calendars for the first time
 (4) The months in calendars bear the names of Roman emperors
17. Which of the following was the holy city of Jews?
 (1) Bethlehem (2) Rome
 (3) Babylon (4) Jerusalem
18. Which of the following regions was called "Burmingham of Africa"?
 (1) Nigeria (2) Ethiopia
 (3) Egypt (4) Sudan
19. An explorer identified American continent in his expedition to India and named the islands as West Indies. Name the country to which he belonged.
 (1) Italy (2) Spain
 (3) China (4) Portugal
20. Identify the statement which does not represent Maya civilization.
 (1) Maya civilization spread in Goutemala and Hounderus.
 (2) People of this civilization had the knowledge of iron.
 (3) People of this civilization divided an year into 365 days.
 (4) People had no knowledge of potter's wheel.
21. Which of the following American territories was associated with Aztec civilization?
 (1) Honderus (2) Equidor
 (3) Peru (4) Mexico
22. Identify the American sovereign state which has the Goddess 'Aztec' as their national symbol.
 (1) Equidar (2) Peru
 (3) Chile (4) Mexico
23. The term 'Souhalt' was associated with which of the following?
 (1) Language in the old testment of bible
 (2) Language in use during Aztec civilization
 (3) The name given to the people of Aztec civilization
 (4) The name given to the people of Inkes civilization
24. What was the common feature found in Illiad, Animid and Odyssey?
 (1) They were all famous Greek paintings
 (2) They were all famous Greek sculptures
 (3) They were the kingdoms associated with Roman empire
 (4) They were famous works in Greek literature
25. After the name of which explorer, the continent of America was given that name?
 (1) Vespuchi (2) Columbus
 (3) Vasco-da-gama (4) Fahian

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

1. 1	2. 1	3. 1	4. 4	5. 4	6. 1	7. 3	8. 3	9. 4	10. 4
11. 3	12. 1	13. 2	14. 3	15. 2	16. 3	17. 1	18. 2	19. 1	20. 1
21. 1	22. 2	23. 1	24. 1	25. 3					

PRACTICE EXERCISE 11 (B)

1. 2	2. 4	3. 3	4. 1	5. 2	6. 2	7. 4	8. 1	9. 1	10. 4
11. 4	12. 4	13. 3	14. 4	15. 3	16. 4	17. 4	18. 3	19. 4	20. 2
21. 4	22. 4	23. 2	24. 4	25. 1					

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GEOGRAPHY

PART 7

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Resources and Development, Forest and Wild Life Resources

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. On the basis of their continued availability, resources are classified as
 - (1) renewable and non-renewable resources.
 - (2) potential and actual resources.
 - (3) metallic and non-metallic resources.
 - (4) None of these
2. What types of resources are rocks and metals?
 - (1) Abiotic
 - (2) Biotic
 - (3) Renewable
 - (4) None of these
3. Which one of the following is a non-renewable resource?
 - (1) Cotton
 - (2) Thermal electricity
 - (3) Wood
 - (4) Livestock
4. Resources which are surveyed for their quality and quantity have been determined for utilization are called
 - (1) Potential Resources
 - (2) Actual Resources
 - (3) Biotic Resources
 - (4) None of these
5. In which one of the following states is terrace cultivation practised?
 - (1) Punjab
 - (2) Haryana
 - (3) Plains of Uttar Pradesh
 - (4) Uttaranchal (Uttarakhand)
6. The most important river in India is
 - (1) The Ganga
 - (2) The Godavari
 - (3) The Krishna
 - (4) The Kavery
7. India's plain land area is about
 - (1) 42%.
 - (2) 63%.
 - (3) 83%.
 - (4) 93%.
8. Rio de Janeiro Earth summit, 1992 aims at
 - (1) achieving global sustainable development.
 - (2) Increasing global food production.
 - (3) Encouraging free trade.
 - (4) identification of resources in developing countries.
9. Who said these words, "There is enough for everybody's need and not for everybody's greed?"
 - (1) George Washington
 - (2) Rabindranath Tagore

- (3) John Kennedy
(4) Mahatma Gandhi
10. Which of the following countries did not develop their resources?
(1) USA (2) Japan
(3) Russia (4) Nepal
11. Which of the following basic resources are not needed for agriculture?
(1) Wind (2) Land
(3) Soil (4) Water
12. Economic development of a region depend on
(1) needs and aspirations of the people.
(2) technological development.
(3) availability of resources.
(4) all of the above.
13. In which of the following minerals Brazil is leading?
(1) Zinc (2) Coal
(3) Copper (4) Iron ore
14. The most fertile soil is
(1) red soil (2) alluvial soil
(3) laterite soil (4) mountainous soil
15. The endangered species of animals are
(1) Rhino (2) Tiger
(3) Indian Bustard (4) All of these
16. The number of plant species considered to be endangered in India are
(1) 350 (2) 450
(3) 1000 (4) 1500
17. The species which are not found after searching known areas where they may occur is
(1) Endangered Species
(2) Extinct Species
(3) Rare Species
(4) Normal Species
18. Name two endangered species of wildlife among the following.
(1) Tiger (2) Elephant
(3) Deer (4) Rhinoceros
19. Which one of the following movements is not associated with the protection of trees?
(1) Chipko movement (2) Navdanya Andolan
(3) Project Tiger (4) Beej Bachao Andolan
20. The state that is famous for the mining of diamond is
(1) Uttar Pradesh (2) Madhya Pradesh
(3) Tamil Nadu (4) Andhra Pradesh
21. Which one of the following mineral is used for the production of Thermal Power?
(1) Coal (2) Uranium
(3) Thorium (4) Crude oil
22. The mineral in which our country is surplus is
(1) Manganese (2) Lime Stone
(3) Tin (4) Silver
23. Teakwood is found in which of the following forests?
(1) Evergreen (2) Tidal
(3) Deciduous (4) Montane
24. In which of the following states is Periyar Tiger Reserve located?
(1) Tamil Nadu (2) Assam
(3) Madhya Pradesh (4) Kerala
25. Which one of the following method is used in Western and Central Himalayas for the soil conservation?
(1) Terrace farming
(2) Strip cropping
(3) Shelter belts
(4) None of the above
26. The Ghana Bird Sanctuary is located in
(1) Madhya Pradesh (2) Rajasthan
(3) West Bengal (4) Kerala
27. Where is Gold found in India?
(1) Kolar (Karnataka)
(2) Khetri (Rajasthan)
(3) Panna (M P)
(4) Katni (M P)
28. Maximum amount of coal in India is used in
(1) Railways (2) Steamships
(3) Energy resources (4) Iron and steel plants
29. How much of the world's land area is tropical rainforest?
(1) 2% (2) 5%
(3) 7% (4) 9%
30. Rajasthan has rich deposits of copper in the district of
(1) Jaipur (2) Bikaner
(3) Nagapur (4) Jhunjhunu

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- Directions for questions 1 to 30:** Select the correct alternative from the given choices.

 - Which type of resource is iron ore?
 - Renewable
 - Biotic
 - Flow
 - Non-renewable
 - The first international earth summit was held in
 - 1991
 - 1992
 - 1993
 - 1995
 - Soil formed by intensive leaching is
 - alluvial soil
 - red soil
 - laterite soil
 - desert soil
 - Human beings, flora and fauna, fisheries, and live stocks are
 - abiotic resources
 - biotic resources
 - potential resources
 - actual resources
 - In which of the following states is black soil found?
 - Jammu and Kashmir
 - Gujarat
 - Rajasthan
 - Jharkhand
 - A developed nation among the following is
 - Indonesia
 - Bangladesh
 - America
 - Sri Lanka
 - Environmental Pollution is caused by
 - Production of Hydro electricity.
 - Canal irrigation.
 - Plantation agriculture.
 - Indiscriminate use of resources.
 - Land left without cultivation in order to enable it to regain its natural fertility is called
 - Barren land
 - Grazing land
 - Fallow land
 - Uncultivated land
 - Which one of the following is not an "Abiotic Resource"?
 - Rocks
 - Metals
 - Fish
 - Minerals
 - Resources that are found everywhere are called
 - localized resources.
 - ubiquitous resources.
 - biotic resources.
 - abiotic resources.
 - The major coal deposits in the world are in
 - South Africa
 - Australia
 - Antarctica
 - Russia
 - Which one of the following products is not derived during oil refining?
 - Hydrogen gas
 - Petrol
 - Diesel
 - Kerosene
 - The highest fold mountains in India are
 - The Aravallis
 - The Vindhya
 - The Himalayas
 - The Eastern Ghats
 - It is estimated that India has _____ species of plants.
 - 49,000
 - 42,000
 - 45,000
 - 50,000
 - When was Project Tiger launched in India?
 - In 1973
 - In 1972
 - In 1983
 - In 1974
 - The total number of species of plants, animals and microorganisms living on the earth is called
 - Bio-diversity
 - Flora
 - Fauna
 - Ecosystem
 - Species which is in danger of extinction is
 - rare species
 - normal species
 - vulnerable species
 - endangered species
 - Kaziranga National Park is in
 - Bihar
 - Assam
 - Uttar Pradesh
 - Madhya Pradesh
 - Which community in India is famous for protecting the black buck?
 - Dogras
 - Santhals
 - Bishnois
 - All of these
 - The Indian Renewable Energy Development Agency Limited (I.R.E.D.A) was set up in the year
 - 1980
 - 1982
 - 1985
 - 1987

21. The famous Digboi, Naharkatiya petroleum deposits are in the state of
 (1) Tamil Nadu (2) Andhra Pradesh
 (3) Maharashtra (4) Assam
22. What is IUCN?
 (1) Indian Union for Conservation of Nature and Natural Resources
 (2) International Union for Conservation of Nature and Natural Resources
 (3) International Union for conservation of Nature
 (4) International Union for Countries Nature and Natural Resources.
23. The Chipko Movement was associated with
 (1) Children exploitation.
 (2) Women empowerment.
 (3) Rights of adivasis.
 (4) Forest conservation.
24. Under which of the following type of resource can tidal energy be put?
 (1) Replenishable (2) Human-made
 (3) Abiotic (4) Non-recyclable
25. In which of the following states deforestation caused land degradation due to mining?
 (1) Andhra Pradesh (2) Jharkhand
 (3) Punjab (4) Madhya Pradesh
26. The potential oil sources in India are in
 (1) Tamil Nadu (2) Assam
 (3) Gujarat (4) All the above
27. Which is the richest soil among the following?
 (1) Black Soil (2) Red Soil
 (3) Laterite Soil (4) Alluvial Soil
28. Temperate forests are likely to have which of the following species of trees?
 (1) Pine (2) Spruce
 (3) Maple (4) All of the above
29. Which of the following is a fossil fuel?
 (1) Petroleum (2) Wood
 (3) Hydrogen (4) Nuclear energy
30. Sunderban Tiger Reserve is in
 (1) Andhra Pradesh (2) Madhya Pradesh
 (3) West Bengal (4) Karnataka

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 1	2. 1	3. 2	4. 1	5. 4	6. 1	7. 1	8. 1	9. 4	10. 4
11. 1	12. 4	13. 2	14. 2	15. 4	16. 4	17. 2	18. 1	19. 3	20. 2
21. 1	22. 1	23. 1	24. 4	25. 1	26. 2	27. 1	28. 3	29. 3	30. 4

PRACTICE EXERCISE 1 (B)

1. 4	2. 2	3. 3	4. 2	5. 2	6. 3	7. 4	8. 3	9. 3	10. 2
11. 4	12. 1	13. 3	14. 2	15. 1	16. 1	17. 4	18. 2	19. 3	20. 4
21. 4	22. 1	23. 4	24. 1	25. 2	26. 4	27. 4	28. 4	29. 1	30. 3

Water Resources and Agriculture

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Water scarcity can be caused by
 - (1) lack of good roads.
 - (2) pollution of natural water reserves.
 - (3) growing population.
 - (4) supply of piped water.
2. Regulating and damning of rivers affects
 - (1) Quality of water
 - (2) Natural flow
 - (3) Utility to man
 - (4) Source of origin
3. How much of world's water exists as fresh water?
 - (1) 3.5 per cent
 - (2) 2.5 per cent
 - (3) 1.5 per cent
 - (4) 4.5 per cent
4. The length of India's coastline is
 - (1) 4100 km
 - (2) 5100 km
 - (3) 5500 km
 - (4) 6100 km
5. The state that has the lowest rainfall is
 - (1) Rajasthan
 - (2) Assam
 - (3) Arunachal Pradesh
 - (4) Himachal Pradesh
6. The winds that give maximum rainfall to India are
 - (1) North-east monsoons
 - (2) South-west monsoons
 - (3) Retreating monsoons
 - (4) Trade winds
7. The construction of Nagarjunasagar is undertaken during the
 - (1) Second five year plan.
 - (2) Third five year plan.
 - (3) First five year plan.
 - (4) Fourth five year plan.
8. The first multi-purpose project of India was
 - (1) Sivasamudram
 - (2) Damodar Valley
 - (3) Hirakud
 - (4) Bhakra Nangal
9. Rainwater harvesting system in mountainous regions is known as
 - (1) Guls
 - (2) Tankas
 - (3) Johads
 - (4) Baolis
10. Bamboo dripirrigation is common in the state of
 - (1) Rajasthan
 - (2) Madhya Pradesh
 - (3) Meghalaya
 - (4) Karnataka

11. _____ is the first and the only state in India which has made roof top rain water harvesting structure compulsory to all the houses across the state.
- (1) Tamil Nadu
 - (2) Andhra Pradesh
 - (3) Maharashtra
 - (4) Madhya Pradesh
12. The longest dam in the world is
- (1) Hirakud Dam
 - (2) Bhakra Dam
 - (3) Nagarjuna Sagar Dam
 - (4) Tungabhadra Dam
13. The total renewable water resources of India are estimated at
- (1) 1,789 km² per annum.
 - (2) 1,978 km² per annum.
 - (3) 1,897 km² per annum.
 - (4) None of these
14. In terms of water availability per person per annum, India ranks
- (1) 130
 - (2) 135
 - (3) 136
 - (4) 133
15. Which of the following river is without a multipurpose project?
- (1) Kaveri
 - (2) Mahanadi
 - (3) Brahmaputra
 - (4) Narmada
16. Which season does wheat correspond to?
- (1) Rabi
 - (2) Kharif
 - (3) Zaid
 - (4) All seasons
17. In which system of agriculture are high doses of fertilizers and pesticides used?
- (1) Extensive agriculture
 - (2) Thooming
 - (3) Intensive agriculture
 - (4) Plantations
18. Slash and burn agriculture is known as _____ in north eastern states.
- (1) Jhumming
 - (2) Pamlou
 - (3) Milpa
 - (4) Bewar
19. Which of the following states is the largest producer of wheat in India?
- (1) Madhya Pradesh
 - (2) Assam
 - (3) Haryana
 - (4) Uttar Pradesh
20. Which one of the following is known as the golden fibre?
- (1) Cotton
 - (2) Jute
 - (3) Hemp
 - (4) Silk
21. Rearing of silkworms for the production of silk fibre is known as
- (1) Sericulture
 - (2) Pisciculture
 - (3) Horticulture
 - (4) Floriculture
22. Indian Council of Agricultural Research (ICAR) is established in
- (1) Pune
 - (2) Jaipur
 - (3) New Delhi
 - (4) Bengaluru
23. Which one of the following is responsible for the procuring and stocking food grains?
- (1) PDS
 - (2) ICA
 - (3) FCI
 - (4) Agmark
24. Which one of the following is much in vogue today with reference to the agriculture?
- (1) Green revolution
 - (2) Use of Pesticides
 - (3) Organic farming
 - (4) Chemical based farming
25. In which of the countries, the 'slash and burn' agriculture is known as 'Roca'?
- (1) Brazil
 - (2) Indonesia
 - (3) Central Africa
 - (4) All of the above
26. Who of the following said these words "Plant more wheat, wheat will win the war"?
- (1) President Thomas Jefferson
 - (2) President Roosevelt
 - (3) President George Bush
 - (4) President Wilson
27. Kharif crops are grown during the
- (1) rainy season
 - (2) summer
 - (3) winter
 - (4) None of these
28. The largest producer of groundnut is
- (1) Gujarat
 - (2) Maharashtra
 - (3) Andhra Pradesh
 - (4) Tamil Nadu
29. Under globalization, our agricultural products are not able to compete with the developed countries because of the

- (1) highly subsidized agriculture in those countries.
- (2) high quality products in these countries.
- (3) high export duties.
- (4) lack of awareness.

30. Who is considered as the father of Indian Green Revolution?

- (1) M.S.Swaminathan (2) Verghese Kurian
- (3) Norman Borlaug (4) Amrita Patel

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Where does 70% of fresh water occur?

- (1) Rivers
- (2) Underground
- (3) Tanks and ponds
- (4) Ice sheets and glaciers

2. Multi-purpose projects help in

- (1) controlling volcanic eruptions.
- (2) enhancing available power supply.
- (3) rehabilitating ousters from submerged areas.
- (4) checking soil erosion.

3. Who gains most from multi-purpose projects?

- (1) Villagers whose lands are submerged
- (2) Dusters who have to go and settle at other places
- (3) Landless labourers
- (4) Urban dwellers and factory owners

4. In India, the total electricity produced from hydro-electric power is

- (1) 32% (2) 25%
- (3) 22% (4) 30%

5. The longest river basin in India is

- (1) Sutlej plain (2) Godavari plain
- (3) Krishna plain (4) Gangetic plain

6. Mawsynram which receives the highest rainfall is in the state of

- (1) Assam (2) Arunachal Pradesh
- (3) Meghalaya (4) Mizoram

7. The word monsoon was derived from

- (1) Greek word (2) Arabic word
- (3) Indian word (4) Latin word

8. The major sources of irrigation are

- (1) Canals (2) Tanks
- (3) Wells (4) All of these

9. Nagarjuna Sagar Dam is constructed on river

- (1) Godavari (2) Thungabhadra
- (3) Krishna (4) Kaveri

10. Which of the following are the two sources of fresh-water in India?

- (1) Sea water
- (2) Rain fall
- (3) Ground water
- (4) Both (2) and (3)

11. Which of the following movement is not against the multi-purpose projects?

- (1) Tehri Dam Movement
- (2) Narmada Bachao Andolan
- (3) Beej Bachao Andolan
- (4) Krishna Godavari Dispute

12. Krishna–Godavari dispute is due to the objections raised by

- (1) Tamil Nadu and Maharashtra governments.
- (2) Karnataka and Andhra Pradesh governments.
- (3) Madhya Pradesh and Gujarat governments.
- (4) None of these

13. The fresh water is continually being renewed and recharged through

- (1) Hydrological cycle
- (2) Carbon cycle
- (3) Nitrogen cycle
- (4) Life cycle

14. Khadins are used in which area to store water?

- (1) Jaisalmer (2) Nagpur
- (3) Mysore (4) Cuttack

15. According to Falken Mark, a Swedish expert, water stress occurs when water availability is between

- (1) 1000 to 1200 cubic metre per person/year
- (2) 1000 to 1050 cubic metre per person/year
- (3) 600 to 900 cubic metre per person/year
- (4) 100 to 1600 cubic meter per person/year

16. Which of the following is the staple food crop of the majority of Indian people?
 (1) Maize (2) Jowar
 (3) Rice (4) Wheat
17. Which country ranks first in the production of sugar-cane?
 (1) Cuba (2) Brazil
 (3) Pakistan (4) Myanmar
18. Who announces Minimum Support Prices for agricultural produce?
 (1) Wholesale Traders
 (2) Agricultural Prices Commission
 (3) Planning Commission
 (4) Village Panchayats
19. Which is the main crop in the north and the north eastern parts of the country?
 (1) Wheat (2) Rice
 (3) Maize (4) Bajra
20. The third most important food crop of our country is
 (1) Rice (2) Wheat
 (3) Jowar (4) Ragi
21. The important crop that helps to restore soil fertility by nitrogen fixation and is also a good source of protein is
 (1) Cereals (2) Pulses
 (3) Vegetables (4) Fruits
22. Who initiated the Bhoodan Movement?
 (1) Baba Amte
 (2) Vinoba Bhave
 (3) Acharya Narendra Dev
 (4) Khan Abdul Gaffar Khan
23. Rice cultivation requires
 (1) high temperature, high humidity and annual rainfall above 100 cm.
 (2) low temperature, low humidity and less rainfall.
 (3) moderate temperature, high humidity and annual rainfall more than 200 cm.
 (4) high temperature, zero humidity and no rainfall.
24. Which one of the following states is associated with the Champaram movement?
 (1) Rajasthan (2) Andhra Pradesh
 (3) Bihar (4) Tamil Nadu
25. Which one of the following is not a cropping season?
 (1) Winter (2) Kharif
 (3) Rabi (4) Zaid
26. Agricultural Revolution first occurred in
 (1) England (2) France
 (3) USA (4) India
27. For poorer farmers machines brought misery because of
 (1) displacement (2) banks refused loans
 (3) banks gave loans (4) indebtedness
28. Green Revolution was launched in
 (1) 1950-51 (2) 1967-68
 (3) 1970-71 (4) 1980-81
29. With which of the following the operation flood is operated?
 (1) Green Revolution (2) White Revolution
 (3) Blue Revolution (4) Industrial Revolution
30. Which state leads in the production of tobacco?
 (1) Andhra Pradesh (2) Madhya Pradesh
 (3) Punjab (4) Uttar Pradesh

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 2 | 3. 2 | 4. 4 | 5. 1 | 6. 2 | 7. 1 | 8. 2 | 9. 1 | 10. 3 |
| 11. 1 | 12. 1 | 13. 3 | 14. 4 | 15. 3 | 16. 1 | 17. 3 | 18. 1 | 19. 4 | 20. 2 |
| 21. 1 | 22. 3 | 23. 3 | 24. 3 | 25. 1 | 26. 4 | 27. 1 | 28. 3 | 29. 1 | 30. 1 |

PRACTICE EXERCISE 2 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 4 | 4. 3 | 5. 4 | 6. 3 | 7. 2 | 8. 4 | 9. 3 | 10. 4 |
| 11. 3 | 12. 2 | 13. 1 | 14. 1 | 15. 3 | 16. 3 | 17. 2 | 18. 2 | 19. 1 | 20. 3 |
| 21. 2 | 22. 2 | 23. 1 | 24. 3 | 25. 1 | 26. 1 | 27. 4 | 28. 2 | 29. 2 | 30. 1 |

Mineral and Energy Resources

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which one of the following is the hardest mineral?
(1) Iron (2) Talc
(3) Bauxite (4) Diamond
2. Which of the following is an example of non-metallic mineral?
(1) Mica (2) Aluminum
(3) Cobalt (4) Manganese
3. Why is Mica used in toothpaste?
(1) It makes toothpaste white.
(2) It makes toothpaste sparkle.
(3) It makes toothpaste soft.
(4) None of these
4. Which one of the following minerals is contained in the monazite sand?
(1) Oil (2) Uranium
(3) Thorium (4) Coal
5. Primary rocks that are of thermal origin are
(1) metamorphic rocks.
(2) sedimentary rocks.
(3) igneous rocks.
(4) None of these
6. Kochi oil refinery is located in
(1) Gujarat
(2) Maharashtra
(3) Kerala
(4) Tamil Nadu
7. Madhya Pradesh is known for the production of which material?
(1) Oil (2) Bauxite
(3) Mica (4) Copper
8. Which one of the following places is known for lignite deposits?
(1) Khetri (2) Neyveli
(3) Bailadila (4) Bokaro
9. In which industry is bauxite or aluminum mainly used?
(1) In textile Industry
(2) In aircraft Industry
(3) In handloom Industry
(4) None of these

10. Which one of the following minerals belongs to the category of ferrous minerals?
(1) Gold (2) Copper
(3) Manganese (4) Bauxite
11. _____ is obtained from the organic waste.
(1) Nuclear energy (2) Solar energy
(3) Bio-gas (4) Bio-mass
12. Sunlight, water, wind and biomass are the
(1) conventional sources of energy.
(2) non-conventional sources of energy.
(3) instant sources of energy.
(4) latent sources of energy.
13. Coal is formed in
(1) metamorphic rocks (2) sedimentary rocks
(3) igneous rocks (4) None of these
14. Iron content in hematite and magnetite is _____ and _____ respectively.
(1) 60%, 62% (2) 68%, 60%
(3) 62%, 60% (4) 60%, 68%
15. The richest coal field of _____ valley is called the Ruhr of India.
(1) Godavari (2) Kaveri
(3) Damador (4) Krishna
16. The metals used in electric industry are
(1) Copper (2) Aluminum
(3) Mica (4) All of these
17. India faces competition from _____ in mica production.
(1) Russia (2) Canada
(3) South Africa (4) Brazil
18. The major thermal power station fed on natural gas is at
(1) Trombay (2) Naharkatiya
(3) Talcher (4) Raniganj
19. The first oil refinery in India was set up at
(1) Bongaigaon (2) Guwahati
(3) Naharkatia (4) Digboi
20. Which of the metropolitan cities produces energy from municipal waste?
(1) Mumbai (2) Chennai
(3) Delhi (4) Kolkata
21. Name the richest, deepest and oldest gold mine of India.
(1) Hutti (2) Gokonda
(3) Kolar (4) Nellore
22. The first nuclear reactor of India is named
(1) Urvashi (2) Apsara
(3) Kamini (4) Rohini
23. A petroleum refinery is located at
(1) Barauni (2) Kanpur
(3) Bihar (4) None of these
24. Which state leads in the production of minerals in terms of value?
(1) Orissa
(2) Gujarat
(3) Madhya Pradesh
(4) Rajasthan
25. Nuclear Power station in Rajasthan is situated at
(1) Kota (2) Pokhara
(3) Jaipur (4) Rawatbhatta
26. The only off-shore oil field in India is
(1) Ankleshwar
(2) Koyali
(3) Vishakhapatnam
(4) Bombay Highway
27. The only nuclear plant that helps in the field of agriculture is at
(1) Narora (2) Kota
(3) Kalpakkam (4) Tarapur
28. The finest quality coal with the highest carbon content is
(1) Lignite (2) Anthracite
(3) Peat (4) Bituminous
29. Which one of the following mineral is obtained from ocean water?
(1) Aluminium
(2) Sulphur
(3) Magnesium
(4) Iron
30. Thermal power plants make use of
(1) fast flowing water.
(2) uranium and thorium.
(3) coal, petroleum and natural gas.
(4) None of these.

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which one of the following minerals is an example of energy mineral?
 - (1) Iron
 - (2) Coal
 - (3) Mica
 - (4) Zinc
2. What is the other name of Galena?
 - (1) Iron
 - (2) Coal
 - (3) Lead
 - (4) Mica
3. Name one industry in which limestone is used as a raw material.
 - (1) Cement industry
 - (2) Small scale industry
 - (3) Textile industry
 - (4) None of these
4. Minerals are deposited and accumulated in the strata of which of the following rocks?
 - (1) sedimentary rocks
 - (2) metamorphic rocks
 - (3) igneous rocks
 - (4) None of these
5. How many thermal power stations are using resources that are non-renewable?
 - (1) 300 power stations
 - (2) 200 power stations
 - (3) 400 power stations
 - (4) 500 power stations
6. The chief importer of Indian iron ore is
 - (1) United kingdom
 - (2) Germany
 - (3) Japan
 - (4) France
7. Which one of the following metals can be obtained from bauxite?
 - (1) Aluminium
 - (2) Copper
 - (3) Iron
 - (4) Silver
8. Which one of the following types of energy production takes place in a belt from Nagercoil to Madurai?
 - (1) Solar
 - (2) Wind
 - (3) Tidal
 - (4) Thermal
9. Which one of the following is costlier source of energy?
 - (1) Coal
 - (2) Natural gas
 - (3) Petroleum
 - (4) Uranium
10. The major power producing corporation of India is the
 - (1) National Hydroelectric Power Corporation (NHPC)
 - (2) North Eastern Electric Power Corporation (NEEPC)
 - (3) Power Grid Corporation of India Limited (PGCIL).
 - (4) National Thermal Power Corporation (NTPC).
11. Which of the following regions of India provides good conditions for utilizing tidal energy?
 - (1) Gulf of Kachchh
 - (2) Gulf of Khambhat
 - (3) Gulf of Goa
 - (4) None of these
12. The largest solar plant of India is situated at
 - (1) Madhapur near Bhuj.
 - (2) Nagar coli in Tamil Nadu.
 - (3) Madurai in Tamil Nadu.
 - (4) None of these
13. India is very rich in
 - (1) Iron ore
 - (2) Bauxite
 - (3) Limestone
 - (4) All of the above
14. The largest plant has been set up in Orissa recently to produce alumina and aluminium which uses the latest technology to save power.
 - (1) French
 - (2) German
 - (3) British
 - (4) Japan
15. A period of the earth's geological history which is about 55 million years old was
 - (1) the primary age.
 - (2) the secondary age.
 - (3) the tertiary age.
 - (4) None of these.
16. Coal mining started in Raniganj in West Bengal in
 - (1) 1700
 - (2) 1765
 - (3) 1774
 - (4) 1779
17. Ananthapur District in Andhra Pradesh is famous for
 - (1) copper
 - (2) zinc
 - (3) mica
 - (4) gold
18. Lignite is low quality coal which is also known as brown coal. Its reserves are concentrated at
 - (1) Neyveli in Tamil Nadu
 - (2) Madurai in Tamil Nadu
 - (3) Nellore in Andhra Pradesh
 - (4) None of these

19. The first explosion of an atomic device was carried out in
 (1) Jammu and Kashmir
 (2) Rajasthan
 (3) Maharashtra
 (4) Karnataka
20. Which one of the following is the oldest atomic power plant?
 (1) Narora
 (2) Tarapur
 (3) Kalpakkam
 (4) Kaiga
21. Rana Pratap Sagar (Rajasthan) is famous for
 (1) Nuclear Power Station
 (2) Aluminum Industry
 (3) Brassware
 (4) Sports Goods
22. Heavy Water Project (Talcher) and fertilizer plant (Paradeep) are famous industries of
 (1) Orissa (2) Tamil Nadu
 (3) Andhra Pradesh (4) Kerala
23. When was Indian iron and steel industry established?
 (1) 1910 (2) 1905
 (3) 1907 (4) 1915
24. The 'Khetri Project' in Rajasthan is for the production of
 (1) zinc (2) steel
 (3) copper (4) aluminium
25. Solar energy can be trapped by
 (1) satellites (2) space stations
 (3) Both of these (4) None of these
26. The largest consumer of oil in the world is
 (1) Russia (2) China
 (3) USA (4) Japan
27. The two states which have exclusive deposits of gas reserve are
 (1) Tripura and Rajasthan
 (2) Gujarat and Mumbai
 (3) Madhya Pradesh and Uttar Pradesh
 (4) None of these
28. Minerals ought to be conserved because
 (1) they are finite and non-renewable.
 (2) they are finite and renewable.
 (3) they are finite but non-renewable.
 (4) None of these.
29. From which of the following ports is iron ore exported from Maharashtra Goa belt?
 (1) Mumbai
 (2) Marmagao
 (3) Kandla
 (4) New Mangalore
30. Kaiga nuclear power plant is located in
 (1) Karnataka (2) Tamil Nadu
 (3) Andhra Pradesh (4) Maharashtra

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

1. 4	2. 2	3. 1	4. 3	5. 2	6. 1	7. 3	8. 1	9. 3	10. 1
11. 3	12. 3	13. 2	14. 1	15. 2	16. 4	17. 2	18. 4	19. 3	20. 4
21. 3	22. 1	23. 2	24. 1	25. 3	26. 4	27. 2	28. 1	29. 3	30. 3

PRACTICE EXERCISE 3 (B)

1. 4	2. 3	3. 4	4. 4	5. 2	6. 1	7. 4	8. 2	9. 3	10. 2
11. 3	12. 1	13. 2	14. 1	15. 1	16. 3	17. 3	18. 3	19. 4	20. 3
21. 4	22. 3	23. 1	24. 1	25. 3	26. 1	27. 3	28. 2	29. 3	30. 1

Manufacturing Industries

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Railways Diesel engines are being manufactured at
 - (1) Varanasi
 - (2) Perambur
 - (3) Chittaranjan
 - (4) Salem
2. How much does the manufacturing sector contribute to India's national economy?
 - (1) 17% of the GDP
 - (2) 20% of the GDP
 - (3) 19% of the GDP
 - (4) 15% of the GDP
3. The economic strength of a country is measured by the development of its
 - (1) Manufacturing industries.
 - (2) Agricultural activities.
 - (3) Banking services.
 - (4) Small scale industries.
4. Which of the following is an agro based industry?
 - (1) Cotton
 - (2) Iron and steel
 - (3) Information technology
 - (4) Electronics industry
5. In which one of the following years, India formulated the National Jute Policy?
 - (1) 2002
 - (2) 2004
 - (3) 2003
 - (4) 2005
6. What is India's position in the production of sugar?
 - (1) 2nd
 - (2) 1st
 - (3) 3rd
 - (4) 4th
7. Iron and steel Industry is a
 - (1) Public Sector Industry.
 - (2) Joint Sector Industry.
 - (3) Heavy Industry.
 - (4) Cooperative Sector Industry.
8. The first cement plant was set up in
 - (1) Mumbai
 - (2) Chennai
 - (3) Kolkata
 - (4) Kanpur
9. What is NTPC?
 - (1) National Temporary Power Corporation
 - (2) National Thermal Power Corporation
 - (3) National Thermal Power Council
 - (4) None of these

10. Bokaro steel plant is started with the assistance of
 - (1) UK
 - (2) USSR
 - (3) France
 - (4) West Germany
11. Which of the following states is the leading producer of Jute products in the country?
 - (1) Madhya Pradesh
 - (2) Andhra Pradesh
 - (3) West Bengal
 - (4) Uttar Pradesh
12. Which of the following is the centre of Petro-chemical industry in Gujarat?
 - (1) Ahmedabad
 - (2) Surat
 - (3) Rajkot
 - (4) Baroda
13. The Mazagaon Dock is located at
 - (1) Chennai
 - (2) Mumbai
 - (3) Gujarat
 - (4) Rajasthan
14. Which of the following regions of India have maximum concentration of iron and steel industry?
 - (1) North Eastern states
 - (2) Malwa Plateau
 - (3) Western Ghats
 - (4) Chhota Nagpur Plateau
15. The biggest shipyard in the country is _____
 - (1) Hindustan shipyard, Vishakhapatnam.
 - (2) Kandla shipyard, Gujarat.
 - (3) Cochin shipyard, Kerala.
 - (4) None of these
16. Which is the only industry in India which is self reliant?
 - (1) Textile industry
 - (2) Iron and steel industry
 - (3) Electrical
 - (4) Sugar
17. Why is there a need to always import cotton?
 - (1) Obsolete industry
 - (2) Increasing demand
 - (3) Shortage in the home market
 - (4) Poor quality in domestic market
18. Which of the following industries helps in the manufacture of telephones computers, radars etc?
 - (1) Aluminium
 - (2) Information Technology
 - (3) Steel
 - (4) Electronics
19. Which of the following industries uses Bauxite as a raw material?
 - (1) Aluminium
 - (2) Steel
 - (3) Jute
 - (4) Cement
20. Air pollution is caused because of the high proportion of undesirable gases such as
 - (1) Methane
 - (2) Hydrogen
 - (3) Sulphur dioxide
 - (4) Carbon
21. A mechanical means of treating industrial effluents
 - (1) Sedimentation.
 - (2) Rainwater harvesting.
 - (3) Recycling of waste water.
 - (4) None of these.
22. In which industry is sal wood used mostly?
 - (1) Railway Sleepers
 - (2) Matches
 - (3) Paper
 - (4) None of these
23. The main centre of diamond cutting industry in India is in
 - (1) Panna
 - (2) Agra
 - (3) Kolar
 - (4) Jaipur
24. The industry that requires the maximum investment of rupees one crore and above is categorized as
 - (1) large scale industry.
 - (2) small scale industry.
 - (3) cottage industry.
 - (4) heavy industry.
25. How many aluminum smelting plants are there in India?
 - (1) 6
 - (2) 8
 - (3) 10
 - (4) 12

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Industries that obtain their raw materials from agriculture are called
 - (1) Heavy industries.
 - (2) Agro based industries.
 - (3) Large scale industries.
 - (4) Light industries.
2. Why were a number of steel plants initially set up in the public sector?
 - (1) Steel mills yield quick returns by way of profits.
 - (2) Steel plants offer great employment opportunities.

- (3) Steel is a basic to industrial development.
- (4) Steel production is necessary for country's defence needs.
3. Which one of the following sectors is associated with the manufacturing industries?
 - (1) Primary sector
 - (2) Secondary sector
 - (3) Tertiary sector
 - (4) Service sector
4. The enterprises like BHEL, GAIL, SAIL, etc., are known as
 - (1) Public sector enterprises.
 - (2) Joint sector enterprises.
 - (3) Private sector enterprises.
 - (4) Cooperative sector enterprises.
5. Which of the following state of India is more famous for their cotton textile industry?
 - (1) Punjab
 - (2) Gujarat
 - (3) Madhya Pradesh
 - (4) Assam
6. The first Jute mill was set up in
 - (1) Hyderabad
 - (2) Bangalore
 - (3) Kolkata
 - (4) Mumbai
7. Which of the following is a major centre of silk textile?
 - (1) Pune
 - (2) Amritsar
 - (3) Ahmedabad
 - (4) Mysore
8. How many primary integrated steel plants are there in India?
 - (1) 10
 - (2) 15
 - (3) 5
 - (4) 20
9. Which of the following emerged as the electronic capital of India?
 - (1) Bangalore
 - (2) Hyderabad
 - (3) Gurgaon
 - (4) Pune
10. The steel plants set up during the second five year plan is
 - (1) Bhilai, Durgapur and Bokaro.
 - (2) Jamshedpur, Durgapur and Bokaro.
 - (3) Bhadravati, Bhilai and Rourkela.
 - (4) Rourkela, Durgapur and Bhilai.
11. Which of the following states is the largest producer of cement in India?
 - (1) Kerala
 - (2) Karnataka
 - (3) Tamil Nadu
 - (4) Andhra Pradesh
12. Agro based industries are those that
 - (1) provide inputs to farmers.
 - (2) use agricultural products as raw material.
 - (3) produce goods consumed in the villages.
 - (4) carry on industrial activity in rural areas.
13. Which of the following are the centres for jute textiles in Andhra Pradesh?
 - (1) Vijayawada and Vishakhapatnam.
 - (2) Warangal and Khammam.
 - (3) Chittivalasa and Nellimarla.
 - (4) Vijayanagaram and Rajahmundry.
14. Which city is called the 'Manchester' of India?
 - (1) Jalandhar
 - (2) Ahmedabad
 - (3) Amritsar
 - (4) Sarnath
15. Environment degradation can be checked by
 - (1) treating hot water and affluent before releasing them into water bodies.
 - (2) recycling and reusing the waste water.
 - (3) using oil or gas instead of coal in factories.
 - (4) all of these.
16. Which of the following is a mineral based industry?
 - (1) Sugar
 - (2) Tea
 - (3) Coffee
 - (4) Petro chemicals
17. Which country has the largest installed capacity of spindles in the world?
 - (1) Japan
 - (2) Phillippines
 - (3) China
 - (4) India
18. What challenges does the jute industry face in India?
 - (1) Poor labour turnover
 - (2) Low productivity of labour
 - (3) Poor market price
 - (4) Competition from synthetic substitutes
19. Which country is the largest producer and consumer of steel in the world?
 - (1) China
 - (2) Japan
 - (3) India
 - (4) United States
20. What is the major contribution of the electronics industry to the country?
 - (1) Maximized wealth information
 - (2) Reduced Poverty
 - (3) Improved standard of living
 - (4) Encouraged employment

21. Public sector plants market their steel through

- (1) TISCO (2) Tata Steel
(3) SAIL (4) GAIL

22. Smoke emitted by chemical and paper factories, refineries etc., can be reduced by using

- (1) coal (2) petrol
(3) gas (4) None of these

23. Out of the following, India earns the maximum foreign exchange from the export of

- (1) leather goods.
(2) engineering goods.

(3) handicrafts.

(4) electronic goods.

24. The industry that has close relation to Hooghly river is

- (1) jute
(2) cement
(3) iron and steel
(4) textiles

25. In which of the following years, India formulated the National Jute Policy?

- (1) 2002 (2) 2004
(3) 2003 (4) 2005

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 1 | 4. 1 | 5. 4 | 6. 1 | 7. 3 | 8. 2 | 9. 2 | 10. 2 |
| 11. 3 | 12. 1 | 13. 2 | 14. 4 | 15. 1 | 16. 1 | 17. 1 | 18. 4 | 19. 1 | 20. 3 |
| 21. 1 | 22. 1 | 23. 4 | 24. 2 | 25. 2 | | | | | |

PRACTICE EXERCISE 4 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 2 | 4. 1 | 5. 2 | 6. 3 | 7. 4 | 8. 1 | 9. 1 | 10. 4 |
| 11. 3 | 12. 2 | 13. 3 | 14. 2 | 15. 4 | 16. 4 | 17. 3 | 18. 4 | 19. 1 | 20. 4 |
| 21. 3 | 22. 3 | 23. 3 | 24. 1 | 25. 4 | | | | | |

Life Lines of National Economy

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. National Highways are under the control of
 - (1) Central government
 - (2) State government
 - (3) Zilla Parishads
 - (4) Mandal and Village panchayats
2. The length of the National Highway Network is quite large in
 - (1) Maharashtra
 - (2) Madhya Pradesh
 - (3) Andhra Pradesh
 - (4) Assam
3. Buckingham Canal connects the two states of
 - (1) Andhra Pradesh and Orissa
 - (2) Andhra Pradesh and Tamil Nadu
 - (3) Madhya Pradesh and Maharashtra
 - (4) Karnataka and Kerala
4. Which one of the following international airport is situated at New Delhi?
 - (1) Nedimbacherry
 - (2) N.T. Rama Rao
 - (3) Indira Gandhi
 - (4) Netaji Subhash Chandra Bose
5. Into how many zones have the Indian Railways been divided?
 - (1) 5
 - (2) 16
 - (3) 7
 - (4) 11
6. Which national highway connects Delhi–Mumbai?
 - (1) NH–7
 - (2) NH–8
 - (3) NH–6
 - (4) None of these
7. Which one of the following is given the special impetus under the Pradhan Mantri Sadak Yojna?
 - (1) Border Roads
 - (2) State Highways
 - (3) Rural Roads
 - (4) District Roads
8. Considering the length of National Highways, Andhra Pradesh occupies the
 - (1) second place
 - (2) third place
 - (3) fourth place
 - (4) fifth place
9. The first railway line was built in India in
 - (1) 1803
 - (2) 1823
 - (3) 1843
 - (4) 1853
10. The air transport was nationalized in India in the year?
 - (1) 1953
 - (2) 1950
 - (3) 1948
 - (4) 1947

11. The Indian railways have a network of _____ stations.
 (1) 7021 (2) 7031
 (3) 7041 (4) 7010
12. Nedimbacherry International Airport is located in which one of the following?
 (1) Tamil Nadu (2) Andhra Pradesh
 (3) Karnataka (4) Kerala
13. In which language are maximum number of newspapers published in India?
 (1) Hindi (2) Marathi
 (3) English (4) Malayalam
14. Which one of the following countries has the largest telecom network in Asia?
 (1) China (2) Japan
 (3) India (4) Sri Lanka
15. What is the name given to the International Airport at Shamshabad in Hyderabad?
 (1) Jawaharlal Nehru International Airport.
 (2) Rajiv Gandhi International Airport.
 (3) Indira Gandhi International Airport.
 (4) None of these
16. Which one of the following rivers is declared National Waterway No.1?
 (1) Indus (2) Ganga
 (3) Godavari (4) Brahmaputra
17. The Public Works Department repairs and builds roads in
 (1) States and Union Territories
 (2) Districts
 (3) Big cities
 (4) Small cities
18. Which one of the following is considered the economic barometer for a country?
 (1) Local trade (2) State level trade
 (3) International trade (4) Internal trade
19. The North-South corridor connects the following
 (1) Srinagar–Kanyakumari
 (2) Delhi–Chennai
 (3) Patna–Kochi
 (4) Shimla–Bengalure
20. National Highway No.1 or the historical Sher Shah Suri Marg links
 (1) Delhi and Kolkata (2) Delhi and Amritsar
 (3) Delhi and Lucknow (4) Delhi and Jalandhar
21. Which of the following ports have been renamed as Jawaharlal Nehru Port?
 (1) Kandla (2) Nhavasheva
 (3) Cochin (4) Mumbai
22. Which State has the highest road density in India?
 (1) Kerala (2) West Bengal
 (3) Karnataka (4) Tamil Nadu
23. The road density of Japan is _____ more than that of India.
 (1) 11 times (2) 12 times
 (3) 13 times (4) 14 times
24. The early postal system in India was solely used for official purposes. It was made available to the public in
 (1) 1837 (2) 1847
 (3) 1857 (4) 1864
25. The means of communication for local mail is called
 (1) Green Channel (2) Satellite Channel
 (3) Metro Channel (4) Rajdhani Channel

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. The Railways are providing employment to
 (1) over 14 lakh employees.
 (2) over 16 lakh employees.
 (3) over 18 lakh employees.
 (4) over 20 lakh employees.
2. Into how many categories Indian roads are classified?
 (1) Two categories (2) Three categories
 (3) Four categories (4) Five categories

3. The National Highway No.7 runs from
 - (1) Delhi to Kanya Kumari.
 - (2) Hyderabad to Machilipatnam.
 - (3) Varanasi to Kanyakumari.
 - (4) Jammu to Bombay.
4. Which of the following National Highway is the longest?
 - (1) NH-7
 - (2) NH-2
 - (3) NH-3
 - (4) NH-1
5. Which seaport was developed soon after independence to ease the volume on Mumbai port?
 - (1) Marmagao
 - (2) Kandla
 - (3) Kochi
 - (4) New Mangalore
6. Which one of the following is an inland riverine?
 - (1) Mumbai
 - (2) Chennai
 - (3) Kolkatta
 - (4) Vizag
7. The largest public sector undertaking in India is
 - (1) the railways.
 - (2) the airways.
 - (3) the roadways.
 - (4) the waterways.
8. Lagoons are being used as waterways in
 - (1) Tamil Nadu
 - (2) Kerala
 - (3) Orissa
 - (4) West Bengal
9. The northern terminal city of North–South corridor is
 - (1) Jammu & Kashmir
 - (2) Srinagar
 - (3) Kanya Kumari
 - (4) None of these
10. What is the full form of NHAI?
 - (1) National Hospitals Authority of India
 - (2) Northern Himalayan Region Airport Investigation
 - (3) National Highway Authority of India
 - (4) National Highest Authority of India
11. Into how many zones are the Indian Railways divided?
 - (1) 20
 - (2) 9
 - (3) 16
 - (4) 28
12. How many people are directly engaged in tourism industry in India?
 - (1) 25 million
 - (2) 20 million
 - (3) 10 million
 - (4) 15 million
13. Which one of the following ports has a natural harbour and a rich hinterland?
 - (1) Tuticorin
 - (2) Paradip
 - (3) Chennai
 - (4) Vishakapatnam
14. Super highways are constructed and maintained by
 - (1) Central Public Works Department.
 - (2) National Highway Authority of India.
 - (3) Road Transport Corporation of India.
 - (4) State Public Works Department.
15. What is the length of the Indian coastline?
 - (1) 7506.1
 - (2) 7516.6
 - (3) 7537.1
 - (4) 6373.6
16. India has inland navigation waterways of _____ km in length.
 - (1) 14,300
 - (2) 14,700
 - (3) 14,500
 - (4) 14,900
17. Which one of the following is contributing to large amount of foreign exchange?
 - (1) Export of gold jewellery.
 - (2) Export of petroleum products.
 - (3) Export of engineering goods.
 - (4) Export of hardwares and softwares.
18. The premier iron-ore exporting port that accounts for about 50% of India's iron ore export is
 - (1) Kochi
 - (2) Paradip
 - (3) Marmagao
 - (4) Haldia
19. Where is the new port of Haldia located?
 - (1) Near Mumbai
 - (2) Near Kandla
 - (3) Near Kolkata
 - (4) Near Chennai
20. The first port, developed soon after independence to ease the volume of trade on the Mumbai port (previously Bombay Port) was
 - (1) Marmagao
 - (2) New Mangalore
 - (3) Kandla
 - (4) Jawaharlal Nehru Port
21. Which is the busiest and the costliest air route in India?
 - (1) Mumbai–Chennai air route
 - (2) Delhi Kolkata air route
 - (3) Mumbai Delhi air route
 - (4) Chennai Delhi air route

22. Which is the most important and the busiest road in India?

- (1) National Highway No.7
- (2) National Highway No.47
- (3) National Highway No.1
- (4) None of these

23. Water transport consist of

- (1) deep-sea navigation.
- (2) coastal navigation.

(3) in land navigation.

(4) All of these

24. The British shifted their capital from Calcutta to New Delhi in

- (1) 1905 (2) 1911
- (3) 1914 (4) 1921

25. Our border roads pass through about _____ states in India.

- (1) 10 (2) 11
- (3) 12 (4) 13

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 2 | 4. 3 | 5. 2 | 6. 2 | 7. 3 | 8. 4 | 9. 4 | 10. 1 |
| 11. 2 | 12. 4 | 13. 1 | 14. 3 | 15. 2 | 16. 2 | 17. 1 | 18. 3 | 19. 1 | 20. 2 |
| 21. 2 | 22. 1 | 23. 4 | 24. 2 | 25. 1 | | | | | |

PRACTICE EXERCISE 5 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 3 | 4. 1 | 5. 2 | 6. 3 | 7. 1 | 8. 2 | 9. 1 | 10. 3 |
| 11. 3 | 12. 4 | 13. 1 | 14. 2 | 15. 2 | 16. 3 | 17. 4 | 18. 3 | 19. 3 | 20. 3 |
| 21. 3 | 22. 3 | 23. 4 | 24. 4 | 25. 3 | | | | | |
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Climate and Soils

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following states has the lowest rainfall?
(1) Rajasthan (2) Assam
(3) Arunachal Pradesh (4) Himachal Pradesh
2. All the regional differences in the climate are described as
(1) Tropical Climate
(2) Continental Climate
(3) Monsoon Climate
(4) None of these
3. There are varied climatic conditions in India due to
(1) nearby seas and the high mountains.
(2) the existence of perennial rivers.
(3) the deserts and plains.
(4) vast area and latitudinal differences.
4. Which one of the following is the main reason for floods to occur?
(1) Excessive temperature
(2) Heavy rainfall
(3) Humidity in air
(4) Anti-cyclones
5. The humid climatic region is
(1) West part of Uttar Pradesh
(2) the Ganga Valley
(3) West coast of Goa
(4) North-west Bengal
6. In which of the following places is the arid type of climate found?
(1) Brahmaputra Valley (2) Deccan Plateau
(3) Rajasthan (4) Ganga Valley
7. The winds that give heavy rainfall in India are
(1) Retreating Monsoons.
(2) North-East Monsoons.
(3) South West Monsoons.
(4) None of these
8. Tropical cyclones cause rains on the
(1) Malabar coast (2) Coromandel coast
(3) Konkan coast (4) Saurashtra coast
9. The most common type of rainfall in India is _____ rainfall.
(1) relief (2) cyclonic
(3) convectional (4) None of these

10. "October Heat" is not experienced mostly in
 - (1) Punjab (2) Haryana
 - (3) Delhi (4) All of these
11. Besides landforms and drainage, which is the third basic element of the natural environment?
 - (1) Temperature (2) Wind
 - (3) Rainfall (4) Climate
12. Why do coastal areas experience less contrasts in temperature conditions?
 - (1) Due to moderating effect of the seas
 - (2) Due to land mass
 - (3) Due to heat conditions
 - (4) None of these
13. The wind flowing in the northern plains in summers is known as
 - (1) Koal Baisakhi (2) Trade winds
 - (3) Loo (4) None of these
14. Black soil is also known as
 - (1) laterite soil (2) alluvial soil
 - (3) regur soil (4) sandy soil
15. Black soils are largely found in
 - (1) Maharashtra (2) Arunachal Pradesh
 - (3) Assam (4) Kerala
16. Name the fertilizer that is used to improve the fertility in alluvial soil.
 - (1) Nitrogen (2) Phosphate
 - (3) Potash (4) Organic material
17. Which of the following schemes are meant for preventing soil erosion?
 - (1) Contour bunding
 - (2) Control of cattle grazing
 - (3) Diversions
 - (4) Shifting cultivation
18. Great civilizations flourished in the areas having
 - (1) Red Soil (2) Mountain Soil
 - (3) Alluvial Soil (4) Black Soil
19. Which of the following states in India is a major producer of tea?
 - (1) West Bengal (2) Assam
 - (3) Tamil Nadu (4) Kerala
20. Calcium carbonate, magnesium carbonate, potash and lime are rich in
 - (1) alluvial soil (2) red soil
 - (3) black soil (4) All of these
21. Which of the following soils has the following features such as sandy and porous, poor in nitrogenous matter and humus?
 - (1) Desert soil (2) Mountain soil
 - (3) Laterite soil (4) Red soil
22. Which one of the following is responsible for the soil erosion in farms?
 - (1) Rivers and wind work
 - (2) Defective methods of farming
 - (3) Flowing water
 - (4) Moving glaciers
23. Which of the following soils is typical in the Deccan trap region?
 - (1) Alluvial soil (2) Black soil
 - (3) Red soil (4) Laterite soil
24. Which of the following methods is used in Western and Central Himalayas for the soil conservation?
 - (1) Terrace farming (2) Strip cropping
 - (3) Shelter belts (4) None of these
25. The soil suitable for cultivation of orchard crops is
 - (1) Alluvial soil (2) Laterite soil
 - (3) Sandy soil (4) Mountainous soil

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Mawsynram which receives the highest rainfall is in the state of
 - (1) Assam
 - (2) Arunachal Pradesh
 - (3) Meghalaya
 - (4) Mizoram
2. The Central Government launched the National Flood control programme in the year
 - (1) 1954 (2) 1956
 - (3) 1958 (4) 1960

3. The average temperature of Rajasthan in the month of June is
 - (1) 30° C
 - (2) 50° C
 - (3) 45° C
 - (4) 40° C
 4. The South West Monsoon comes from
 - (1) the Bay of Bengal
 - (2) the Himalayas
 - (3) Asia
 - (4) the Indian Ocean
 5. Which of the following states experiences severe famine?
 - (1) Kerala
 - (2) Rajasthan
 - (3) Bihar
 - (4) West Bengal
 6. The word monsoon was derived from
 - (1) Greek word
 - (2) Arabic word
 - (3) Indian word
 - (4) Latin word
 7. Which part of India receives rain for almost nine months in the year?
 - (1) Thiruvananthapuram and Shillong
 - (2) Chennai and Mumbai
 - (3) Cochin and Mumbai
 - (4) None of these
 8. Which place has the lowest rainfall?
 - (1) Leh
 - (2) Thiruvananthapuram
 - (3) Chennai
 - (4) Mumbai
 9. Winters are dry in India because
 - (1) winds are from land and sea.
 - (2) winds are from sea to land.
 - (3) winds are from mountainous regions.
 - (4) None of these
 10. The Pre-monsoon showers are a common phenomena in
 - (1) Kerala and the coastal areas of Tamil Nadu.
 - (2) Konkan coast and Saurashtra coast.
 - (3) Coromandel coast and Konkan coast.
 - (4) Kerala and the coasts of Karnataka.
 11. The state of atmosphere over an area at any point of time is known as
 - (1) Weather
 - (2) Climate
 - (3) Heat
 - (4) Cold
 12. Which of the following climatic controls is the most important?
 - (1) Latitude
 - (2) Altitude
 - (3) Pressure and wind system
 - (4) Continentiality
 13. Which of the following soils is suitable for the cultivation of almost all kinds of crops?
 - (1) Black Soil
 - (2) Red Soil
 - (3) Laterite Soil
 - (4) Alluvial Soil
 14. Which one of the following soils is suitable for the cultivation of tea?
 - (1) Red Soil
 - (2) Black Soil
 - (3) Alluvial Soil
 - (4) Laterite Soil
 15. The soil in the delta regions are
 - (1) Black soil
 - (2) Red soil
 - (3) Alluvial soil
 - (4) Mountain soil
 16. Which of the following soils are less fertile and need heavy manuring and irrigation.
 - (1) Alluvial
 - (2) Black
 - (3) Red
 - (4) Laterite
 17. Laterite soils are suitable to grow
 - (1) Coffee, rubber and tea.
 - (2) Wheat, rice and rubber.
 - (3) Jute, maize and millets.
 - (4) Pulses, tea and sugarcane.
 18. Soil erosion caused by winds is high in the state of
 - (1) Madhya Pradesh
 - (2) Andhra Pradesh
 - (3) Rajasthan
 - (4) Gujarat
 19. In the geographical area of our country the soils that occupy the largest area are
 - (1) red soils
 - (2) laterite soils
 - (3) alluvial soils
 - (4) mountain soils
 20. Soils consisting of various proportions of sand, silt and clay predominant in coastal plains and deltas are
 - (1) alluvial soil
 - (2) black soil
 - (3) red soil
 - (4) laterite soil
 21. The percentage of fallow land since independence has come down from 7% to
 - (1) 4%
 - (2) 5%
 - (3) 6%
 - (4) None of these

22. Which of the following soils is generally sandy in texture and saline in nature?

- (1) Arid soil (2) Black soil
(3) Red soil (4) Laterite soil

23. Which one of the following states has laterite soil in abundance?

- (1) Uttar Pradesh (2) Bihar
(3) Rajasthan (4) Meghalaya

24. Soil erosion is prevalent in

- (1) Assam
(2) Eastern Ghats
(3) Siwaliks
(4) Bihar

25. The soil which is soft when wet and very hard when dry is

- (1) Red soil (2) Black soil
(3) Alluvial soil (4) Desert soil

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 3 | 3. 4 | 4. 2 | 5. 2 | 6. 3 | 7. 3 | 8. 2 | 9. 1 | 10. 3 |
| 11. 4 | 12. 1 | 13. 3 | 14. 3 | 15. 1 | 16. 1 | 17. 1 | 18. 3 | 19. 2 | 20. 3 |
| 21. 1 | 22. 2 | 23. 2 | 24. 1 | 25. 4 | | | | | |

PRACTICE EXERCISE 6 (B)

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|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 2 | 4. 4 | 5. 2 | 6. 2 | 7. 1 | 8. 3 | 9. 1 | 10. 4 |
| 11. 2 | 12. 1 | 13. 4 | 14. 4 | 15. 3 | 16. 3 | 17. 1 | 18. 3 | 19. 1 | 20. 1 |
| 21. 2 | 22. 1 | 23. 4 | 24. 4 | 25. 2 | | | | | |
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Places of Interest

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. In which of the following districts is Tirupati located?
(1) Ananthapur (2) Chittoor
(3) Kurnool (4) Nellore
2. In which of the following cities is the Jama Masjid and the Qutb Minar located?
(1) Hyderabad (2) Srinagar
(3) Delhi (4) Shimla
3. 'Tirupati' is situated in the valley of
(1) Ratnagiri Hills (2) Niligiri Hills
(3) Seshachalam Hills (4) Nandidurga Hills
4. Hindustan photo film manufacturing industry is an important industry in
(1) Hyderabad (2) Delhi
(3) Bangalore (4) Ooty
5. Which one of the following cities is the Indian Botanical Gardens situated?
(1) Darjeeling (2) Ooty
(3) Shimla (4) Varanasi
6. In which of the following cities is the famous Viswanath Temple situated?
(1) Kanchi (2) Varanasi
(3) Tirupati (4) Mathura
7. The Capital city of Karnataka state is
(1) Chennai (2) Mysore
(3) Manglore (4) Bangalore
8. Where is the Central Police Training college situated?
(1) Kolkata (2) Mumbai
(3) New Delhi (4) Mount Abu
9. The most populous city in India is
(1) Maharashtra (2) Kolkata
(3) Hyderabad (4) Uttar Pradesh
10. The summer capital of Jammu and Kashmir state is
(1) Jammu (2) Srinagar
(3) Pahalgam (4) Gulmarg
11. The holy place of Varanasi is situated on the bank of river
(1) Brahmaputra (2) Ganga
(3) Kasi (4) Gandaki

12. Which of the following is known as the “Pink City” of India?
 - (1) Jaipur (2) Hyderabad
 - (3) Nasik (4) Luknow
13. Which is the sixth most populous city in India?
 - (1) Bangalore (2) Ooty
 - (3) Delhi (4) Srinagar
14. The world’s famous tourist resort is
 - (1) Shimla (2) Darjeeling
 - (3) Ooty (4) Kashmir
15. Indian space Research Organisation (ISRO) is located in
 - (1) Delhi (2) Hyderabad
 - (3) Shimla (4) Bangalore
16. The Kaziranga national park is located in
 - (1) Gujarat (2) Assam
 - (3) Sikkim (4) Rajasthan
17. The famous Dilevara Temples are situated in
 - (1) Uttar Pradesh
 - (2) Rajasthan
 - (3) Maharashtra
 - (4) Madhya Pradesh
18. The first Indian university which was opened in 1857 in
 - (1) Chennai (2) Bihar
 - (3) Mumbai (4) Kolkata
19. The largest dry rock in India is situated in
 - (1) Mumbai (2) Cochin
 - (3) Marmugao (4) Nasir
20. Bandipur sanctuary is located in the state of
 - (1) Tamil Nadu (2) Uttar Pradesh
 - (3) Karnataka (4) Madhya Pradesh
21. Which city is called the “Manchester of south” India?
 - (1) Coimbatore (2) Chittoor
 - (3) Hubli (4) None of these
22. Ramoji film city is a place of interest in
 - (1) Hyderabad (2) Bangalore
 - (3) Chennai (4) Kolkata
23. The oldest university _____ is in the city of Varanasi.
 - (1) Aligarh University
 - (2) Osmaniya University
 - (3) Benaras Hindu University
 - (4) None of these
24. Which state in India is called the ‘sugar bowl’ of India?
 - (1) Maharashtra (2) Uttar Pradesh
 - (3) Gujarat (4) Madhya Pradesh
25. The biggest commercial centre of South India is
 - (1) Visakhapatnam (2) Mumbai
 - (3) Chennai (4) Madhurai

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The Salarjung Museum is in the city of
 - (1) Hyderabad (2) Delhi
 - (3) Srinagar (4) Shimla
2. Hindustan Machine Tools factory is in the city of
 - (1) Delhi (2) Bangalore
 - (3) Srinagar (4) Varanasi
3. All India Institute of Medical Sciences (AIIMS) and University Grants Commission are located in the city of
 - (1) Delhi (2) Hyderabad
 - (3) Bangalore (4) Srinagar
4. The highest peak in Nilgiris is called
 - (1) the Annapurna Peak
 - (2) the Gurushikar Peak
 - (3) the Dodafetta Peak
 - (4) the Gangotri Peak
5. Which of the following is the holy city of the Christians?
 - (1) Jerusalem in Isreal
 - (2) Mount Sinai in Palestine

- (3) Makkah in Arabia
(4) None of these
6. The town famous for silk industry is
(1) Chennai (2) Varanasi
(3) Tirupati (4) Venkatagiri
7. Which one of the following cities is known as Paradise on earth?
(1) Ooty (2) Bangalore
(3) Srinagar (4) Chennai
8. The famous Dal Lake is in
(1) Jammu (2) Amritsar
(3) Srinagar (4) Lucknow
9. India Gate and Redfort are places of interest in
(1) Secunderabad (2) New Delhi
(3) Kanyakumari (4) Jodhpur
10. Ooty is situated in
(1) Niligiri Hills
(2) Eastern Ghats
(3) Western Ghats
(4) Seshachalam Hills
11. Srinagar is situated on the bank of the river
(1) Sindhu (2) Sutlej
(3) Jhelum (4) Chenab
12. Which of the following is the famous Tank that separates Hyderabad and Secunderabad?
(1) Musi (2) Tank Bund
(3) Hussain sagar (4) Salarjung
13. Which one of the following cities is known for coffee and tea plantations?
(1) Shimla (2) Mount Abu
(3) Ooty (4) Srinagar
14. Which of the following is the legendary fort that marks the glory of Qutub Shahis?
(1) Charminar
(2) Golconda
(3) Salarjung
(4) Deccan
15. Which one of the following cities is known as the Garden City of Indian?
(1) Tirupathi
(2) Visakhapatnam
(3) Bangalore
(4) Hyderabad
16. The Queen of the Arabian sea is
(1) Mumbai Port
(2) Cochin Port
(3) Kandla Port
(4) New Mangalore Port
17. The centre for cellular and Molecular Biology is situated at
(1) Patna (2) Jaipur
(3) Hyderabad (4) New Delhi
18. Bijapur is known for its
(1) severe drought condition.
(2) gol gumbaz.
(3) heavy rainfall.
(4) statue of Gomatesuara.
19. Which is the oldest monuments?
(1) Qutub Minar (2) Ajenda Caves
(3) Khajuraho (4) Taj Mahal
20. The satellite launching station is located at
(1) Sriharikota (Andhra Pradesh).
(2) Sholapur (Maharashtra).
(3) Salem (Tamil Nadu).
(4) Warangal (Andhra Pradesh).
21. The Red Fort of Delhi was built by
(1) Akbar (2) Shahjehan
(3) Jehangir (4) Shersha
22. Which one of the following bio-reserves of India is not included in the world network of bio-reserves?
(1) Manas (2) Gulf of Mannar
(3) Nilgiri (4) Nanda Devi
23. Which one of the following was the summer Capital of Government of India from the year 1865 to 1939?
(1) Ooty (2) Shimla
(3) Bangalore (4) Delhi
24. Which of the following are the two most populated metropolitan cities?
(1) Mumbai and Delhi
(2) Delhi and Kolkata
(3) Mumbai and Kolkata
(4) Chennai and Mumbai
25. In which of the following cities is the shiva temple located?
(1) Delhi (2) Shimla
(3) Srinagar (4) None of these

ANSWER KEYS

PRACTICE EXERCISE 7 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 3 | 4. 4 | 5. 2 | 6. 2 | 7. 4 | 8. 4 | 9. 4 | 10. 2 |
| 11. 2 | 12. 1 | 13. 1 | 14. 4 | 15. 4 | 16. 2 | 17. 2 | 18. 4 | 19. 3 | 20. 3 |
| 21. 1 | 22. 1 | 23. 3 | 24. 2 | 25. 3 | | | | | |

PRACTICE EXERCISE 7 (B)

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|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 1 | 4. 3 | 5. 1 | 6. 4 | 7. 3 | 8. 3 | 9. 2 | 10. 1 |
| 11. 3 | 12. 2 | 13. 3 | 14. 2 | 15. 3 | 16. 2 | 17. 3 | 18. 2 | 19. 2 | 20. 1 |
| 21. 2 | 22. 3 | 23. 2 | 24. 3 | 25. 3 | | | | | |
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Sea Ports and Towns

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The biggest port having three major docks in India is
 - (1) Mumbai
 - (2) Kolkata
 - (3) Chennai
 - (4) Cochin
2. The two natural harbours in India are
 - (1) Mumbai and Kolkata.
 - (2) Chennai and Paradeep.
 - (3) Cochin and Visakhapatnam.
 - (4) Kandla and New Mangalore.
3. Which of the following port lies at the tip of the Indian Peninsula?
 - (1) Paradeep
 - (2) New Mangalore
 - (3) Tuticorin
 - (4) Visakhapatnam
4. Indian vessels carried about _____ per cent of the total seaborne trade in 1993–94.
 - (1) 30
 - (2) 32
 - (3) 33
 - (4) 34
5. Which one of the following is the important imports of Kolkata Port?
 - (1) Tea
 - (2) Sugar
 - (3) Jute products
 - (4) Fertilizers
6. Kolkata port is situated on the banks of river
 - (1) Ganga
 - (2) Narmada
 - (3) Hooghly
 - (4) Mahanadi
7. Which one of the following is the port of Orissa?
 - (1) Cochin
 - (2) Tuticorin
 - (3) Paradeep
 - (4) Kolkata
8. Visakhapatnam port serves the need of
 - (1) Bhilai steel plant.
 - (2) Bokaro steel plant.
 - (3) Rourkela steel plant.
 - (4) Bhilai and Rourkela steel plants.
9. The first port in India which will be touched by all the ships coming from Europe is
 - (1) Madras
 - (2) Kolkata
 - (3) Cochin
 - (4) Mumbai
10. _____ port is located on the cross roads of east and west.
 - (1) Chennai
 - (2) Cochin
 - (3) Kolkata
 - (4) Mumbai

11. The Kandla sea port is in the state of
 - (1) Gujarat
 - (2) Maharashtra
 - (3) Chennai
 - (4) Orissa
12. Which of the following port is on the western coast of India?
 - (1) Paradip
 - (2) Enmore
 - (3) Tuticorin
 - (4) Marmagao
13. Which one of the following is the important Channel of navigation in Europe?
 - (1) Volga waterway
 - (2) St Lawrance waterway
 - (3) Thames waterway
 - (4) Rhine waterway
14. Where was the 13th major seaport established in India?
 - (1) Andaman and Nicobar island
 - (2) Goa
 - (3) Karnataka
 - (4) Andhra Pradesh
15. How many minor ports are there in India?
 - (1) 135
 - (2) 100
 - (3) 300
 - (4) 150
16. How many public sector shipping companies are there in India?
 - (1) 5
 - (2) 4
 - (3) 1
 - (4) 6
17. Which artificial harbour is located on the east coast?
 - (1) Kochi
 - (2) Kolkata
 - (3) Kandla
 - (4) Chennai
18. OTEC refers to
 - (1) oceanic mineral resources.
 - (2) tidal and wave energy.
 - (3) ocean thermal gradient energy.
 - (4) None of these.
19. India has about _____ kilometers of navigable waterways comprising of rivers, canals, back waters and creeks etc.
 - (1) 14,000
 - (2) 14,500
 - (3) 14,200
 - (4) 14,300
20. Which one of the following is the oldest port in east coast?
 - (1) Cochin
 - (2) Kolkata
 - (3) Chennai
 - (4) Khandla
21. The length of India's coastline is about
 - (1) 7,500 km
 - (2) 5,900 km
 - (3) 7,000 km
 - (4) 6,100 km
22. Water covers _____ per cent of the total surface area of the earth.
 - (1) 66
 - (2) 71
 - (3) 75
 - (4) 90
23. Konkan coast extends from Gujarat to Goa. It has
 - (1) deltas
 - (2) estuaries
 - (3) lagoons
 - (4) None of these
24. Which of the following ports have been renamed as Jawaharlal Nehru Port?
 - (1) Kandla
 - (2) Nhavasheva
 - (3) Cochin
 - (4) Mumbai
25. Which of the following is the biggest and busiest port for exports?
 - (1) Kandla
 - (2) Hooghly
 - (3) Mumbai
 - (4) Chennai

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The Queen of the Arabian sea is

- (1) Mumbai port
- (2) Cochin port
- (3) Kandla port
- (4) New Mangalore port

2. The port on the east coast of India exporting iron ore to Japan is

- (1) Mangalore
- (2) Chennai
- (3) Tuticorin
- (4) Vishakhapatnam

3. Which one of the following port is the second largest one handling sea borne trade?
 - (1) Visakhapatnam (2) Cochin
 - (3) Chennai (4) Kolkata
4. Which one of the following cities is the largest city in India?
 - (1) Delhi (2) Madras
 - (3) Hyderabad (4) Mumbai
5. Chennai is the largest port in
 - (1) Northern India (2) Southern India
 - (3) Western India (4) Middle India
6. Which one of the following is the fourth largest city in India?
 - (1) Chennai (2) Visakhapatnam
 - (3) Mumbai (4) Hyderabad
7. Which one of the following is the biggest commercial centre of south India?
 - (1) Mumbai (2) Chennai
 - (3) Visakhapatnam (4) Madhurai
8. Which one of the following is an important export from Visakhapatnam?
 - (1) Crude (2) Petroleum
 - (3) Fertilizers (4) Iron ore
9. The share of Mumbai Port in the sea borne trade of India is
 - (1) One-fourth (2) One-third
 - (3) One-fifth (4) One-sixth
10. Which of the following years was the Chennai Port built?
 - (1) 1852 (2) 1855
 - (3) 1859 (4) 1854
11. Which one of the following is a land locked harbour?
 - (1) Kolkata (2) Visakhapatnam
 - (3) Chennai (4) Mumbai
12. How many major sea port are there in India?
 - (1) 10 (2) 8
 - (3) 14 (4) 12
13. The second major west flowing river system in India is
 - (1) the Narmada river (2) the Sabarmati river
 - (3) the tapti river (4) the Sharavati river
14. The Mississippi Ohio waterway connects the interior parts of the USA with
 - (1) Gulf of Mexico in the south.
 - (2) Sargosa sea in South east.
 - (3) Gulf of California in south west.
 - (4) Pacific Ocean in the west.
15. From which river has the Rajasthan canal (Indira Gandhi Canal) been taken out?
 - (1) Ravi (2) Chambal
 - (3) Sutlej (4) Beas
16. Which one is not a major port on the east coast?
 - (1) Paradeep (2) Kolkata
 - (3) Kochi (4) Visakhapatnam
17. What is the most abundant element in sea water?
 - (1) Sodium (2) Chlorine
 - (3) Iodine (4) Potassium
18. Which of the following major sea ports of India does not have a natural harbour?
 - (1) Mumbai (2) Cochin
 - (3) Marmagao (4) Paradeep
19. Which one of the following port is a Tidal port?
 - (1) Khandla (2) Marmagao
 - (3) Kochi (4) Nhava Sheva
20. Which states share the Tungabhadra multi purpose project?
 - (1) Karnataka and Madhya Pradesh
 - (2) Orissa and Madhya Pradesh
 - (3) Andhra Pradesh and Karnataka
 - (4) Tamil Nadu and Andhra Pradesh
21. The major ports are administered by the _____
 - (1) State Government.
 - (2) Central Government.
 - (3) Private agencies.
 - (4) None of these
22. The difference between high tide and low tide is
 - (1) tidal range (2) tidal width
 - (3) tidal height (4) None of these
23. The water transport consists of
 - (1) deep sea navigation.
 - (2) coastal navigation.
 - (3) inland navigation.
 - (4) All of these

24. Hinterland is

 - (1) the area in the sea coast to land the ships.
 - (2) the area immediately behind the port.
 - (3) the area used to repair the ships.
 - (4) None of these
25. Which of the following rives are navigable?

 - (1) River Mandir in Goa
 - (2) River Baraks in Assam
 - (3) River Krishna and River Godavari in Peninsular India
 - (4) All of these

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 3 | 3. 3 | 4. 4 | 5. 4 | 6. 3 | 7. 3 | 8. 4 | 9. 4 | 10. 2 |
| 11. 1 | 12. 4 | 13. 4 | 14. 1 | 15. 1 | 16. 3 | 17. 4 | 18. 3 | 19. 2 | 20. 3 |
| 21. 4 | 22. 2 | 23. 2 | 24. 2 | 25. 3 | | | | | |

PRACTICE EXERCISE 8 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 3 | 4. 4 | 5. 2 | 6. 1 | 7. 2 | 8. 4 | 9. 1 | 10. 3 |
| 11. 2 | 12. 4 | 13. 3 | 14. 1 | 15. 3 | 16. 3 | 17. 2 | 18. 3 | 19. 1 | 20. 3 |
| 21. 2 | 22. 1 | 23. 4 | 24. 2 | 25. 4 | | | | | |
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Population

PRACTICE EXERCISE 9 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following countries is the most populous country in the world?
(1) India (2) China
(3) USA (4) Russia
2. Which of the following is the most populous state of India?
(1) Maharashtra (2) Bihar
(3) Uttar Pradesh (4) Gujarat
3. The number of states accounted for more than two-thirds of the country's population are
(1) five states (2) six states
(3) seven states (4) eight states
4. Which of the following is the least populous state in the country?
(1) Meghalaya (2) Mizoram
(3) Goa (4) Sikkim
5. Regular census in India are held every 10 years. In which year was the first regular census held in India?
(1) 1921 (2) 1881
(3) 1911 (4) 1931
6. The population of India in 2011 is
(1) 118 crores (2) 119 crores
(3) 120 crores (4) 121 crores
7. In which part of India are the zoroastrian population concentrated?
(1) Andhra Pradesh (2) Gujarat
(3) Karnataka (4) Maharashtra
8. Migrations change the number, distribution and composition of the population in
(1) the area of departure.
(2) the area of arrival.
(3) both the area of departure and arrival.
(4) None of these
9. According to 2011 census, which is the most populated city of India?
(1) Delhi (2) Coimbatore
(3) Mumbai (4) Hyderabad
10. Which of the following year was the year of demographic divide?
(1) 1919 (2) 1921
(3) 1924 (4) 1926

11. Which of the following statements defines the density of population?
 - (1) Number of persons living per unit area
 - (2) Number of persons living in a country
 - (3) Change in the number of inhabitants of a country during a specific period
 - (4) Absolute numbers added every year
12. Which of the following states/union territories has the lowest sex ratio in India?
 - (1) Kerala
 - (2) Puducherry
 - (3) Delhi
 - (4) Haryana
13. Which of the following states is the biggest state in terms of area?
 - (1) Haryana
 - (2) Andhra Pradesh
 - (3) Rajasthan
 - (4) Uttar Pradesh
14. Which of the following state has high density of population?
 - (1) West Bengal
 - (2) Arunachal Pradesh
 - (3) Himachal Pradesh
 - (4) None of these
15. Rapid growth of population in developing nations has resulted in environmental
 - (1) pollution
 - (2) degradation
 - (3) promotion
 - (4) All of these
16. Over population is a situation when the
 - (1) resources are too much for the size of population.
 - (2) resources are too few for the size of population
 - (3) emigration is more than immigration.
 - (4) None of these
17. Moderate density of population in a region means
 - (1) 50–100 persons per km²
 - (2) 60–100 persons per km²
 - (3) 75–100 persons per km²
 - (4) None of these
18. India occupies the _____ place in geographical area.
 - (1) sixth
 - (2) fifth
 - (3) seventh
 - (4) eight
19. In terms of urban population _____ ranked first.
 - (1) Uttar Pradesh
 - (2) Maharashtra
 - (3) Madhya Pradesh
 - (4) Haryana
20. Which among the following union territories _____ has the highest proportion of urban population?
 - (1) Sikkim
 - (2) Assam
 - (3) Meghalaya
 - (4) Delhi
21. According to 2011 census, India's share in total world population is
 - (1) 16%
 - (2) 15%
 - (3) 17%
 - (4) 20%
22. What is the density of population per sq km according to 2011 census?
 - (1) 382 persons
 - (2) 380 persons
 - (3) 385 persons
 - (4) 383 persons
23. Since independence, how many times has the census been taken?
 - (1) Three
 - (2) Seven
 - (3) Five
 - (4) Six
24. The highest population growth during 1991–2001 has been recorded at
 - (1) Manipur
 - (2) Nagaland
 - (3) Sikkim
 - (4) Uttarakhand
25. National Population Policy in India was implemented in the year
 - (1) 1999
 - (2) 2000
 - (3) 2003
 - (4) 2000

PRACTICE EXERCISE 9 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following is the second most populous country in the world?
 - (1) Pakistan
 - (2) India
 - (3) Bangladesh
 - (4) Sri Lanka
2. The period that was regarded a 'moderate' in the case of growth of population is
 - (1) 1921–1951
 - (2) 1931–1961
 - (3) 1941–1971
 - (4) 1951–1981

3. The largest proportion of rural population is found in
 - (1) Himachal Pradesh (2) Nagaland
 - (3) Lakshadweep (4) Tripura
4. Which of the following states has the largest number of towns in the country?
 - (1) Madhya Pradesh (2) Andhra Pradesh
 - (3) Maharashtra (4) Uttar Pradesh
5. Which of the following is the national language of India?
 - (1) Telugu (2) Hindi
 - (3) English (4) Tamil
6. Which of the following union territory has the highest population?
 - (1) Delhi (2) Chandigarh
 - (3) Lakshadweep (4) Daman Diu
7. Which of the following states is the second highly populated state in India?
 - (1) Uttar Pradesh
 - (2) Andhra Pradesh
 - (3) Maharashtra
 - (4) West Bengal
8. The magnitude of population growth refers to
 - (1) the total population of an area.
 - (2) the number of persons added each year.
 - (3) the rate at which the population increases.
 - (4) the number of females per thousand males.
9. What percentage of the world population live in India?
 - (1) 18.6% (2) 17.7%
 - (3) 16.7% (4) 17.9%
10. Which of the following is the most literate state in India?
 - (1) Uttar Pradesh (2) Andhra Pradesh
 - (3) Maharashtra (4) Kerala
11. Working population includes those persons who fall in the age group of
 - (1) 6–14 years (2) 0–15 years
 - (3) +60 years (4) 15–5 years
12. Which of the following year did the government of India initiate the comprehensive family planning programme?
 - (1) 1950 (2) 1952
 - (3) 1953 (4) 1951
13. In which year was the first census held in India?
 - (1) 1889 (2) 1890
 - (3) 1891 (4) 1892
14. Which of the countries of Asia including _____ has two-thirds of the world's population?
 - (1) Bangladesh (2) Pakistan
 - (3) Russia (4) None of these
15. Which of the following countries have not increased population by migration?
 - (1) Europe (2) North America
 - (3) South America (4) Australia
16. The record which tells about births, deaths, migration etc., is
 - (1) density of population.
 - (2) total population.
 - (3) census.
 - (4) average density of population.
17. The population of India has increased from 23.8 crores in 1901 to _____ crores in 2001.
 - (1) 100.7 (2) 102.7
 - (3) 101.8 (4) 100.9
18. The lowest density of 13 persons per square kilometer is found in the state of
 - (1) Arunachal Pradesh
 - (2) Madhya Pradesh
 - (3) Haryana
 - (4) Punjab
19. Which of the following is the least ranked urban populated state?
 - (1) Delhi (2) Punjab
 - (3) Sikkim (4) Arunachal Pradesh
20. More than half of India's urban population lives in _____ states.
 - (1) three (2) five
 - (3) four (4) six
21. What is Net-Reproduction rate?
 - (1) Number of deaths of children below one year of age per 1000 live birth
 - (2) Birth rate minus death rate
 - (3) Average age to which a person at the time of his birth is expected to live
 - (4) The rate at which women are replaced by daughter who will have children.

22. Which among the following countries was the first in the world to officially sponsor family planning programmes to control population?
- (1) China (2) Venezuela
(3) India (4) Myanmar
23. Population of how many countries had crossed one billion mark by the year 2011?
- (1) 3 (2) 1
(3) 2 (4) None of these
24. In which of the following cities in India the first family clinic opened?
- (1) Kerala
(2) Karnataka
(3) West Bengal
(4) Punjab
25. Which of the following cities has got the highest sex ratio in India ?
- (1) Puducherry (2) Salem
(3) Hubli (4) Hyderabad

ANSWER KEYS

PRACTICE EXERCISE 9 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 3 | 4. 4 | 5. 2 | 6. 4 | 7. 4 | 8. 3 | 9. 3 | 10. 2 |
| 11. 1 | 12. 3 | 13. 3 | 14. 1 | 15. 2 | 16. 2 | 17. 1 | 18. 3 | 19. 2 | 20. 4 |
| 21. 3 | 22. 1 | 23. 2 | 24. 2 | 25. 4 | | | | | |

PRACTICE EXERCISE 9 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 1 | 3. 1 | 4. 4 | 5. 2 | 6. 1 | 7. 3 | 8. 2 | 9. 3 | 10. 4 |
| 11. 4 | 12. 2 | 13. 4 | 14. 3 | 15. 1 | 16. 3 | 17. 2 | 18. 1 | 19. 3 | 20. 2 |
| 21. 4 | 22. 3 | 23. 3 | 24. 1 | 25. 1 | | | | | |

India: Size, Location and Physical Features

PRACTICE EXERCISE 10 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. India is a
 - (1) Continent
 - (2) Sub continent
 - (3) Island
 - (4) None of these
2. From north to south, India covers a distance of about
 - (1) 2,800 km
 - (2) 3,600 km
 - (3) 3,200 km
 - (4) 3,000 km
3. In the south, India is bounded by the
 - (1) Bay of Bengal
 - (2) Arabian sea
 - (3) Indian Ocean
 - (4) Maldives
4. The largest island in terms of area are
 - (1) Dadra and Nagar Haveli.
 - (2) Daman and Diu.
 - (3) Andaman and Nicobar.
 - (4) Lakshadweep.
5. The largest state in the Indian Union in terms of area is
 - (1) Andhra Pradesh
 - (2) Uttar Pradesh
 - (3) Rajasthan
 - (4) Arunachal Pradesh
6. Which of the following island is the smallest in terms of area?
 - (1) Dadra and Nagar Haveli
 - (2) Chandigarh
 - (3) Lakshadweep
 - (4) Daman and Diu
7. The border line that separates India and China is
 - (1) Mac Mohan line
 - (2) Radcliff line
 - (3) Palk strait
 - (4) None of these
8. The latitude that passes nearly midway across the country is
 - (1) Equator
 - (2) Tropic of Cancer
 - (3) Tropic of Capricorn
 - (4) 45° Northern latitude
9. The difference between Green wich Time and Indian Standard Time is
 - (1) 5 hours
 - (2) 51/2 hours
 - (3) 6 hours
 - (4) 61/2 hours
10. Which of the following country has boundary with India in the north?
 - (1) Nepal
 - (2) Pakistan
 - (3) China
 - (4) USSR

11. Which of the following is the southern most tip of the Indian main land?
 - (1) Trinkat (2) Cape Camorin
 - (3) Cape Capricorn (4) None of these
12. The Northern mountain ranges of the Gondwana land are
 - (1) the Aravallis.
 - (2) the Raj Mahal Hills.
 - (3) the Meghalayan Hills.
 - (4) All of these
13. Pass is a natural route between two mountain ranges. The pass on the Tibet Himalayan road in Himachal Pradesh is
 - (1) Bomdila Pass (2) Bhorghat Pass
 - (3) Shipkila Pass (4) Nathula Pass
14. Which of the following are the oldest mountains in India?
 - (1) The Vindhyas (2) The Aravallis
 - (3) The Sahyadri (4) The Himalayas
15. The Malwa Plateau is surrounded in the north by
 - (1) The Aravallis
 - (2) the Hindu Kush
 - (3) the Vindhyas.
 - (4) the Deccan Plateau
16. River Brahmaputra forms a gorge at
 - (1) Nathula Pass (2) Bomdila Pass
 - (3) Namcha Barwa (4) None of these
17. The easternmost longitude of India is
 - (1) 97°, 25' E (2) 68°, 7' E
 - (3) 77°, 6' (4) 82°, 32' E
18. In which of the following territories of India is Kavaratti located?
 - (1) Puducherry (2) Andaman and Nicobar
 - (3) Lakshadweep (4) Diu and Daman
19. What is the rank of India in the world countries in respect of area?
 - (1) 8 rank (2) 6 rank
 - (3) 7 rank (4) 9 rank
20. Mountain ranges in the eastern part of India forming its boundary with Myanmar are collectively called as
 - (1) Himachal (2) Purvanchal
 - (3) Uttaranchal (4) None of these
21. The highest peak in the eastern ghats is
 - (1) Anai Mudi (2) Mahendragiri
 - (3) Kanchenjunga (4) Khasi
22. Why do western slopes of western Ghats receive orographic rainfall?
 - (1) Due to facing slopes of the south west monsoon
 - (2) Due to western disturbances
 - (3) Due to tropical cyclones
 - (4) Due to convectional rainfall
23. Which is the highest mountain peak of India?
 - (1) The Karokonam (2) The Kanchenjunga
 - (3) The Nangaparbhat (4) The Nanda Devi
24. Which amongst the following rivers flows through a rift valley?
 - (1) Mahanadi (2) Krishna
 - (3) Thungabhadra (4) Tapi
25. The tropic of cancer does not pass through
 - (1) Rajasthan (2) Orissa
 - (3) Chandigarh (4) Tripura

PRACTICE EXERCISE 10 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following place, does India stands in terms of extent?
 - (1) Fourth place
 - (2) Fifth place
 - (3) Third place
 - (4) First place
2. How many countries share the common land frontiers with India?
 - (1) Four (2) Five
 - (3) Six (4) Seven
3. Which of the following states has the longest coast-line?
 - (1) Andhra Pradesh (2) Tamil Nadu
 - (3) West Bengal (4) Maharashtra

4. At present, India is union of
 - (1) 28 states and 7 union territories.
 - (2) 25 states and 7 union territories.
 - (3) 27 states and 5 union territories.
 - (4) 28 states and 4 union territories.
5. The number of coastal states in the Indian union is
 - (1) six
 - (2) nine
 - (3) seven
 - (4) five
6. Which of the following is the Headquarters of Daman and Diu?
 - (1) Silvassa
 - (2) Daman
 - (3) Port Blair
 - (4) Puducherry
7. Which of the following states stands on the three seas?
 - (1) Kerala
 - (2) Tamil Nadu
 - (3) Karnataka
 - (4) Maharashtra
8. The state that has both summer and winter capital is
 - (1) Assam
 - (2) Himachal Pradesh
 - (3) Jammu & Kashmir
 - (4) Andhra Pradesh
9. What is the length of India's coastline?
 - (1) About 4100 km
 - (2) About 5100 km
 - (3) About 5500 km
 - (4) About 6100 km
10. Which of the following line separate India and Pakistan?
 - (1) Radcliff
 - (2) Mac Mohan
 - (3) Palkstrait
 - (4) None of these
11. Which of the following do not have common border with Myanmar?
 - (1) Nagaland
 - (2) Arunachal Pradesh
 - (3) Assam
 - (4) Manipur
12. Which state has assumed the name due to the clouds cover throughout the year?
 - (1) Tripura
 - (2) Manipur
 - (3) Meghalaya
 - (4) Nagland
13. Which of the Himalayan ranges are more destructive?
 - (1) Himachal
 - (2) Himadri
 - (3) Karakoram
 - (4) Shiwaliks
14. Except Narmada and Tapi all the peninsular rivers flow towards east because
 - (1) the deccan plateau is sloping towards the east.
 - (2) the rivers are not perennial.
 - (3) the rivers rise from western ghats.
 - (4) the rivers have many tributaries.
15. The height of Mount Everest is
 - (1) 8153 m
 - (2) 8848 m
 - (3) 8126 m
 - (4) 8175 m
16. The big Himalayan rivers joining the Ganga down stream of Allahabad from west to east are
 - (1) Gandak, Ghagra, Gomti and Kosi
 - (2) Gomti, Ghagra, Gandak and Kosi
 - (3) Ghagra, Gomti, Kosi and Gandak
 - (4) None of these
17. Uttaranchal, Uttar Pradesh, Bihar, West Bengal and Sikkim have common frontiers with
 - (1) China
 - (2) Bhutan
 - (3) Nepal
 - (4) Myanmar
18. State the geographical area of India along with its percentage in relation to world area.
 - (1) 33.6 lakh km², it is 2.2% of the world area
 - (2) 32.8 lakh km², it is 2.4% of the world area
 - (3) 32.1 lakh km², it is 2.8% of the world area
 - (4) None of these
19. Why there is a time lag of two hours from Gujarat to Arunachal Pradesh?
 - (1) Because of India's east west extent
 - (2) Because of India's north south extent
 - (3) Because of India's proximity to oceans
 - (4) Because of land mass
20. The western coastal strip, south of Goa is referred to as
 - (1) Coromandal
 - (2) Konkan
 - (3) Kannad
 - (4) Northern Circar
21. Which of the Lakshadweep islands has a bird sanctuary?
 - (1) Nicobar island
 - (2) Pitti Island
 - (3) Barren island
 - (4) Diu island
22. How have northern plains been formed?
 - (1) By the interplay of three river systems Indus, Ganga and Brahmaputra
 - (2) By the interplay of two river systems Narmada and Tapi
 - (3) By the interplay of two river systems, Godavari and Krishna
 - (4) By the interplay of all these river system

23. Which one of the following is the longest river of the Peninsular India?

- (1) Narmada
- (2) Godavari
- (3) Krishna
- (4) Mahanadi

24. Name the huge ancient landmass which consisted of India, Australia, South Africa and South America as one single landmass.

- (1) Angara land
- (2) Canadian shield
- (3) Gondwana land
- (4) Tethys sea

25. In between the Vindhyas and the Aravallis _____ lies.

- (1) Bundelkhand Plateau
- (2) Bhaghel Khand Plateau
- (3) Malwa Plateau
- (4) Deccan Plateau

ANSWER KEYS

PRACTICE EXERCISE 10 (A)

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|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 3 | 4. 3 | 5. 3 | 6. 3 | 7. 1 | 8. 2 | 9. 2 | 10. 3 |
| 11. 2 | 12. 4 | 13. 3 | 14. 2 | 15. 1 | 16. 3 | 17. 1 | 18. 3 | 19. 3 | 20. 2 |
| 21. 2 | 22. 1 | 23. 2 | 24. 4 | 25. 2 | | | | | |

PRACTICE EXERCISE 10 (B)

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|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 4 | 3. 1 | 4. 1 | 5. 2 | 6. 2 | 7. 2 | 8. 3 | 9. 4 | 10. 1 |
| 11. 3 | 12. 3 | 13. 4 | 14. 1 | 15. 2 | 16. 2 | 17. 1 | 18. 2 | 19. 1 | 20. 3 |
| 21. 2 | 22. 1 | 23. 2 | 24. 3 | 25. 3 | | | | | |

Natural Regions of the World

PRACTICE EXERCISE 11 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The characteristic type of rainfall in the equatorial region is
 - (1) cyclonic rainfall.
 - (2) convectional rainfall.
 - (3) orographic rainfall.
 - (4) None of these
2. Which of the cities is the largest in the equatorial region?
 - (1) Djakarta
 - (2) Buenos Aires
 - (3) Singapore
 - (4) Rio de Janeiro
3. The equatorial region is confined to
 - (1) Amazon Basin
 - (2) Congo Basin
 - (3) Some parts of Asia
 - (4) All of these
4. Rainfall in the equatorial region ranges from 150 cm to
 - (1) 400 cm
 - (2) 300 cm
 - (3) 500cm
 - (4) 600 cm
5. Which of the following is the only continent that does not have a hot desert?
 - (1) North America
 - (2) South America
 - (3) Antarctica
 - (4) Australia
6. Which of the following primitive tribe is found in the tropical hot deserts?
 - (1) The Semang
 - (2) The Bushmen
 - (3) The Pygmies
 - (4) The Sakai
7. Rainfall in the hot deserts is
 - (1) moderate
 - (2) highest
 - (3) lowest
 - (4) None of these
8. The Atacama desert lies between ____ and ____ south latitudes.
 - (1) 5° and 41°
 - (2) 4° and 31°
 - (3) 3° and 21°
 - (4) None of these
9. The 'Victoria falls' is on the river
 - (1) Columbia
 - (2) Amazon
 - (3) Zambezi
 - (4) Orinaco
10. In the Savanna lands, great population densities are found in
 - (1) Jamaica and Cuba
 - (2) Nigeria
 - (3) Sudan
 - (4) All of these
11. In the Savanna lands tin and coal are mined in
 - (1) Venezuela
 - (2) Jamaica
 - (3) Zaire
 - (4) Nigeria

12. Which of the following region is characterized by a season of rain followed by a season of drought?
 - (1) Equatorial region (2) Hot desert region
 - (3) Savanna region (4) Steppe region
13. The grasslands of South America are called
 - (1) Downs (2) Velds
 - (3) Pampas (4) Steppes
14. Which of the following places are famous for possessing innumerable gold deposits in the world?
 - (1) Witwaters Rand (2) Kimberley
 - (3) Madrid (4) Tashkant
15. The grasslands of North America are called
 - (1) Pampas (2) Prairies
 - (3) Downs (4) Steppes
16. Which of the following countries is known as “the land of the living fossils”?
 - (1) New Zealand (2) Canada
 - (3) Australia (4) None of these
17. Which of the following countries has the largest number of cattle in the world?
 - (1) Australia (2) Taiwan
 - (3) India (4) Sri Lanka
18. The average rainfall in July in the monsoon lands is
 - (1) 150 cm (2) 200 cm
 - (3) 360 cm (4) 277 cm
19. Large estates known as Haciendas are present in
 - (1) Italy (2) Greece
 - (3) Chile (4) California
20. The countries of monsoon climate consists of thick
 - (1) tropical deciduous forest.
 - (2) tropical evergreen forests.
 - (3) Desert vegetation.
 - (4) None of these
21. Which of the following regions has the characteristic features of four distinct seasons and reversal of wind?
 - (1) Desert region
 - (2) Monsoon region
 - (3) Taiga region
 - (4) Polar region
22. Wheat is the crop grown in
 - (1) Pampas of South America.
 - (2) Velds of Africa.
 - (3) Downs of Australia.
 - (4) Prairies of North America.
23. Which of the following cities is the largest in the Taiga lands of North America?
 - (1) Murmansk
 - (2) Archangel
 - (3) Fairbanks
 - (4) Irkutsk
24. The Mediterranean lands receive rainfall during
 - (1) Summer (2) Spring
 - (3) Autumn (4) Winter
25. The natives of the North-American tundra are known as
 - (1) the Lapps (2) the Bushmen
 - (3) the Pygmies (4) the Eskimos

PRACTICE EXERCISE 11 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following is the wettest place in the equatorial region?
 - (1) Cherrapunji (2) Mt Waialeale
 - (3) Mawsynram (4) Mt Cameroon
2. Rainy tropics is the name of
 - (1) Equatorial region (2) Desert region
 - (3) Savanna (4) Steppe
3. What is the belt of low pressure encircling the earth near the equator called?
 - (1) Katabatic winds
 - (2) Antarctic Blizzards
 - (3) Doldrums
 - (4) Roaring forties
4. In the island of Java in Indonesia _____ is the main crop.
 - (1) Wheat (2) Maize
 - (3) Rice (4) Jowar

5. Death valley, the second hottest place in the world, is in _____ desert.
 - (1) the Sahara
 - (2) the Australia
 - (3) the Arabia
 - (4) the Sonoran
6. Largest tropical desert in the southern hemisphere is
 - (1) the Australian desert
 - (2) the Kalahari desert
 - (3) the Atacama desert
 - (4) the Sonoran desert
7. The Australian desert covers about _____ per cent of that continent.
 - (1) 40%
 - (2) 30%
 - (3) 50%
 - (4) 35
8. In which of the following countries Savanna lands are known as the 'campos'?
 - (1) Brazil
 - (2) Venezuela
 - (3) Cuba
 - (4) Senegal
9. The place receiving the highest amount of rainfall in the world is
 - (1) Cherrapunji
 - (2) Mt. Waialeale
 - (3) Mt Cameroon
 - (4) Mawsynram
10. Which of the following is called the Sugar Bowl of the world?
 - (1) Hawana
 - (2) Venezuela
 - (3) Cuba
 - (4) Zaire
11. The major producer of petroleum in Savanna lands is
 - (1) Venezuela
 - (2) Cuba
 - (3) Hawana
 - (4) Jamaica
12. Mount Waialeale in the Hawaiian islands gets an annual rainfall of
 - (1) 1234.4 cm
 - (2) 1334 cm
 - (3) 1434 cm
 - (4) 1534 cm
13. The temperate grasslands of Eurasia are called as
 - (1) Steppes
 - (2) Downs
 - (3) Prairies
 - (4) Velds
14. Which of the following place is famous for Diamonds?
 - (1) Madrid
 - (2) Tashkant
 - (3) Kimberely
 - (4) Ankara
15. Best quality of wool is drawn from the Angora goats found in
 - (1) USA
 - (2) Egypt
 - (3) Turkey
 - (4) China
16. Which of the following is the wettest place in the monsoon region?
 - (1) Cherrapunji
 - (2) Mt Waialeale
 - (3) Mt Cameroon
 - (4) Mawsynram
17. The country having the largest area under sugar cane cultivation in the monsoon region is
 - (1) Myanmar
 - (2) India
 - (3) Thailand
 - (4) Bangladesh
18. Which of the following is the only monsoon region where commercial agriculture is practiced?
 - (1) Australia
 - (2) New Zealand
 - (3) Pakistan
 - (4) Sri Lanka
19. The total area occupied by the Mediterranean region in the world is about
 - (1) 1 per cent
 - (2) 2 per cent
 - (3) 3 per cent
 - (4) 4 per cent
20. Treeless grasslands are called
 - (1) Pampas
 - (2) Steppes
 - (3) Prairies
 - (4) Downs
21. Mahagony, ebony and green heart are the trees in
 - (1) Coniferous forests.
 - (2) Evergreen forests.
 - (3) Monsoon forests.
 - (4) All of these
22. The equatorial region has
 - (1) hot and wet climate throughout the year.
 - (2) red and yellow soils of low fertility.
 - (3) tall hard wood trees from a cover.
 - (4) All of these
23. Cold Pole is the title of the
 - (1) Eurasian region.
 - (2) Siberian region.
 - (3) Tundra region.
 - (4) Mediterranean region.
24. The total area occupied by the Mediterranean region in the world is about
 - (1) 1 per cent
 - (2) 2 per cent
 - (3) 3 per cent
 - (4) 4 per cent
25. Which of the following border the Taiga region?
 - (1) Grass Tundra
 - (2) Bush Tundra
 - (3) Desert Tundra
 - (4) None of these

ANSWER KEYS

PRACTICE EXERCISE 11 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 4 | 4. 2 | 5. 3 | 6. 2 | 7. 3 | 8. 2 | 9. 3 | 10. 4 |
| 11. 4 | 12. 3 | 13. 3 | 14. 1 | 15. 2 | 16. 3 | 17. 3 | 18. 4 | 19. 2 | 20. 1 |
| 21. 2 | 22. 4 | 23. 3 | 24. 4 | 25. 4 | | | | | |

PRACTICE EXERCISE 11 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 1 | 3. 3 | 4. 3 | 5. 4 | 6. 1 | 7. 1 | 8. 1 | 9. 2 | 10. 3 |
| 11. 1 | 12. 1 | 13. 1 | 14. 3 | 15. 1 | 16. 4 | 17. 2 | 18. 1 | 19. 1 | 20. 2 |
| 21. 2 | 22. 4 | 23. 2 | 24. 1 | 25. 2 | | | | | |



CIVICS

PART 8

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Power Sharing, Federalism

PRACTICE EXERCISE 1 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Who among the following launched the panchayt raj?
(1) Pt Jawaharlal Nehru
(2) Dr Rajendra Prasad
(3) Sachidanand Sinha
(4) Dr Ambedkar
2. Which one of the following state in India has its own constitution?
(1) Manipur
(2) Tamil Nadu
(3) J & K
(4) Assam
3. The draft of the Preamble was prepared by _____.
(1) Rajendra Prasad
(2) Dr B.R. Ambedkar
(3) Jawaharlal Nehru
(4) None of these
4. President is a part of _____.
(1) Supreme Court
(2) High Court
(3) Parliament
(4) None of these
5. Which of the following state is governed by central government?
(1) Kerala
(2) Chandigarh
(3) Nagaland
(4) Manipur
6. Which of the following country is an example for 'holding together' federations?
(1) Australia
(2) USA
(3) Spain
(4) None of these
7. In which of the following states are Indians who are not residents of that state, a not allowed to buy property of any form?
(1) Arunachal Pradesh
(2) Jammu and Kashmir
(3) Mizoram
(4) Rajasthan
8. How many languages are recognized as scheduled languages?
(1) 21
(2) 22
(3) 23
(4) 24
9. Prudential reasons of power sharing are
(1) the stability of political order.
(2) to reduce the possibility of conflict between social groups.
(3) a fair share to minority.
(4) All of the above

10. Which form of government is prevalent in Sri Lanka?
 - (1) Majoritarianism
 - (2) Federal
 - (3) Unitary government
 - (4) Community government
11. Sri Lanka emerged as an independent nation in _____.
 - (1) 1948
 - (2) 1943
 - (3) 1953
 - (4) 1958
12. Power can be shared in modern democracies _____.
 - (1) among different organs of government.
 - (2) among governments at different levels.
 - (3) among different social groups.
 - (4) All of the above
13. How many tiers of government are provided by Indian constitution?
 - (1) Two
 - (2) Three
 - (3) Four
 - (4) Five
14. Which one of the following subjects is included in the union list?
 - (1) Foreign affairs
 - (2) Police
 - (3) Agriculture
 - (4) Irrigation
15. Both the union as well as the state governments can make laws on the subjects mentioned in _____ list.
 - (1) union
 - (2) concurrent
 - (3) state
 - (4) Both (a) and (b)
16. Which of the following federation was added later to the Indian federation?
 - (1) The judiciary
 - (2) The legislature
 - (3) The reservation
 - (4) The panchayats and municipalities
17. After independence, the first state organized on the basis of language is _____.
 - (1) Tamil Nadu
 - (2) Kerala
 - (3) Karnataka
 - (4) Andhra Pradesh
18. The authority to alter the boundaries of states in India rests with _____.
 - (1) State government.
 - (2) President.
 - (3) Prime Minister.
 - (4) Parliament.
19. The authority empowered to make laws in respect to the three lists is _____.
 - (1) supreme court
 - (2) state legislature
 - (3) president
 - (4) parliament
20. On the subject of income tax _____.
 - (1) the union government has more powers than the state governments.
 - (2) the state governments have more powers than the union government.
 - (3) Both the union and the state governments have equal powers.
 - (4) only the union government has powers.
21. The distinguishing feature of a federal government is _____.
 - (1) National government gives some powers to the provincial government
 - (2) Power is distributed among the legislature, executive and judiciary
 - (3) Governing or ruling power is divided between different levels of government
 - (4) Elected officials exercise supreme power in the government
22. Which of the following statements is not the federal characteristic of the constitution?
 - (1) Division of powers between the union and states.
 - (2) Independent supreme court as a federal court.
 - (3) The upper House of the parliament represents the states of the union.
 - (4) None of the above
23. Which one of the following communities is not related to Sri Lanka?
 - (1) Sri Lankan Tamils
 - (2) Dutch
 - (3) Sinhalese
 - (4) Indian Tamils
24. Which of the following country is the head quarter of the European union?
 - (1) USA
 - (2) France
 - (3) Belgium
 - (4) Australia
25. The functioning of executive or laws made by legislatures are checked by the _____.
 - (1) Judiciary
 - (2) Parliament
 - (3) Both (1) and (2)
 - (4) None of the above
26. What is the percentage of German speaking people in Belgium?
 - (1) 30%
 - (2) 59%
 - (3) 10%
 - (4) 01%

27. Which two languages are generally spoken in Belgium?
 (1) French and Sinhala (2) Dutch and French
 (3) Dutch and Sinhala (4) English and Dutch
28. On which date the constituent assembly adopted the Indian constitution?
 (1) 15 August, 1947 (2) 26 January, 1947
 (3) 26 November, 1949 (4) 26 January, 1949
29. India is called a secular state because_____
 (1) people have the supreme right to make decisions.
 (2) head of the state is an elected person.
 (3) people should live like brothers and sister.
 (4) government will not favour any religion.
30. Which of the following statements about the president of India is not correct?
 (1) He is the supreme commander of the defence forces of the union.
 (2) The executive power of the union is vested in the president.
 (3) He is the real head of the council of ministers of the union.
 (4) He is a constituent part of Indian parliament.

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- What form of government exists in India?
 (1) Union (2) Federal
 (3) Central (4) None of the above
- In which of the following cities is the federal court situated?
 (1) Delhi (2) Bangalore
 (3) Agra (4) Mumbai
- Which of the following word is not there in the Preamble?
 (1) Justice (2) Equality
 (3) Freedom (4) Fraternity
- In case of any dispute about the division of powers. The decision is taken by the
 (1) High court
 (2) Supreme court
 (3) Parliament
 (4) High courts and Supreme court
- Which of the following country is an example for 'coming together' federation?
 (1) Belgium (2) Spain
 (3) Nepal (4) Switzerland
- Which of the following will come under concurrent list?
 (1) Police (2) Trade, commerce
 (3) Education (4) Banking
- Who among the following appoints the chief justice of supreme court?
 (1) High court judges (2) Supreme court judges
 (3) Prime minister (4) President
- The report of the states reorganization commission (SRC) was implemented on _____
 (1) 1 November 1956 (2) 2 October 1957
 (3) 2 October 1956 (4) 1 November 1957
- The major social groups of Sri Lanka are _____.
 (1) Sinhalese and Dutch
 (2) Dutch and Sri Lankan Tamils
 (3) Sinhalese and Sri Lankan Tamils
 (4) French and Dutch
- Belgium government is a good example of _____
 (1) Monarchy.
 (2) Community government.
 (3) Unitary government.
 (4) Federal government.
- When was Belgium declared independent?
 (1) 1840 (2) 1850
 (3) 1860 (4) 1830
- Which among the following are examples of 'coming together federations'?
 (1) Belgium, Switzerland and USA
 (2) India, Belgium and USA
 (3) USA, Switzerland and Sri Lanka
 (4) Switzerland, USA and Australia

13. In 'holding together federation' which government tends to be more powerful?
- (1) Central
 - (2) State
 - (3) Some times central and some time state
 - (4) Both have equal power
14. Which one of the following subjects is included in the state list?
- (1) Banking
 - (2) Currency
 - (3) Communications
 - (4) Agriculture
15. How many seats in local government are reserved for women?
- (1) $2/3^{\text{rd}}$
 - (2) $1/4^{\text{th}}$
 - (3) $3/5^{\text{th}}$
 - (4) $1/3^{\text{rd}}$
16. _____ is a system of government in which the power is divided between central authority and various constituents of the country.
- (1) Unitary
 - (2) Democracy
 - (3) Federalism
 - (4) None of these
17. In which of the following lists of Indian constitution is the subject of 'population' control and family planning included?
- (1) Union list
 - (2) Concurrent list
 - (3) State list
 - (4) Residuary list
18. Which of the following federal principles are found in the Indian Federation?
- (a) Equal representation of states in the Second House of Parliament
 - (b) Bicameral Legislature at federal level
 - (c) Double citizenship
 - (d) Independent and Impartial judiciary
- (1) (a), (b) and (c)
 - (2) (b), (c) and (d)
 - (3) (b) and (d)
 - (4) (a) and (c)
19. In coalition government, power sharing is _____
- (1) among different organs of government.
 - (2) among governments at different levels.
 - (3) by different social groups.
 - (4) by two or more political parties.
20. The idea of the concurrent list is borrowed from the constitution of _____.
- (1) Canada
 - (2) Australia
 - (3) USA
 - (4) Japan
21. Which one of the following statements is not the feature of Indian constitution?
- (1) Double citizenship.
 - (2) Single constitution for both centre and states (except J&K).
 - (3) Integrated judicial system.
 - (4) All of the above
22. Which of the following statements is not correct regarding unitary government?
- (1) There are two or more tiers of governments
 - (2) The sub-units of the government are subordinate to the central government
 - (3) The power of the union (parliament) to legislate on the matter included in the state list.
 - (4) None of the above
23. Which one of the following languages was recognized as the official language of Sri Lanka in 1956?
- (1) English
 - (2) Tamil
 - (3) Urdu
 - (4) Sinhala
24. How many times was Belgium constitution amended between 1970 to 1993?
- (1) Three times
 - (2) Four times
 - (3) Five times
 - (4) Six times
25. Who elects the community government in Belgium?
- (1) The community leaders of Belgium
 - (2) The citizens of the whole country
 - (3) By the leaders of Belgium
 - (4) None of the above
26. What is the percentage of Dutch speaking people in Belgium?
- (1) 59%
 - (2) 01%
 - (3) 10%
 - (4) 30%
27. Who was the chairman (or president) of the constituent assembly?
- (1) Dr B.R. Ambedkar
 - (2) Dr Rajendra Prasad
 - (3) Motilal Nehru
 - (4) Sarojini Naidu
28. Who was the chairman of drafting committee?
- (1) Dr B.R. Ambedkar
 - (2) Dr Rajendra Prasad
 - (3) Motilal Nehru
 - (4) Sarojini Naidu

29. Which of the following country that has been under dictatorship for long?

- (1) Belgium
- (2) Sri Lanka
- (3) Brazil
- (4) Switzerland

30. Which one of the following is not correct with respect to a Constitution Amendment bill?

- (1) It can be introduced only in the Lok Sabha.
- (2) A joint meeting of the two Houses cannot be summoned to resolve the differences between the two houses with respect to such a bill.
- (3) The president cannot withdraw his assent from such a bill if passed by two houses of parliament.
- (4) Such a bill has to be passed by special majority in each house of the parliament.

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 1	2. 2	3. 1	4. 3	5. 2	6. 3	7. 2	8. 2	9. 2	10. 3
11. 1	12. 4	13. 2	14. 1	15. 2	16. 4	17. 4	18. 4	19. 4	20. 4
21. 3	22. 4	23. 2	24. 3	25. 1	26. 4	27. 2	28. 3	29. 4	30. 3

PRACTICE EXERCISE 1 (B)

1. 2	2. 1	3. 3	4. 4	5. 4	6. 3	7. 4	8. 1	9. 3	10. 2
11. 4	12. 4	13. 1	14. 4	15. 4	16. 3	17. 2	18. 3	19. 4	20. 2
21. 1	22. 1	23. 4	24. 2	25. 2	26. 1	27. 1	28. 1	29. 3	30. 1

Democracy and Diversity

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which of the following statements is true of democracy?
 - (1) Democracy is not suitable for large countries with wide social diversities.
 - (2) Democracy is most suitable to accommodate social diversities.
 - (3) Democracy creates social divisions among political parties.
 - (4) Democracy does not provide scope for dissent.
2. Which of the following is not the basis of social divisions in India?
 - (1) Language
 - (2) Health
 - (3) Region
 - (4) Caste
3. Who started the Civil Rights Movement in USA?
 - (1) John Milton
 - (2) Martin Luther king
 - (3) John F Kennedy
 - (4) George Bush (Sr)
4. The black gloved and raised clenched fists of Tommie Smith and John Carlos were meant to symbolize
 - (1) Black power.
 - (2) The US policy of racial discrimination.
 - (3) White power.
 - (4) Their pride while listening to the US national anthem.
5. Most of the social differences are based on
 - (1) Birth
 - (2) Choice
 - (3) Caste
 - (4) Religion
6. Tommie Smith and John Carlos received their medals wearing black socks and no shoes
 - (1) to support civil rights movement
 - (2) to represent black poverty
 - (3) to show black power
 - (4) None of these
7. Which sect of Christianity has the maximum following in Great Britain?
 - (1) Catholics
 - (2) Catholics and Ebionites
 - (3) Ebionites
 - (4) Protestants
8. At present, which of the following forms of government, is adopted by most countries?
 - (1) Monarchy
 - (2) Democracy
 - (3) Dictatorship
 - (4) Military rule

9. Which country/countries got its/their independence after 1945?
 - (1) India (2) Pakistan
 - (3) Ghana (4) All of these
10. Which of the following is not a democratic country?
 - (1) India (2) USA
 - (3) China (4) UK
11. One of the main challenges to the working of democracy in India is:
 - (1) Casteism and communalism
 - (2) Social and economic equality
 - (3) Universal Adult Franchise
 - (4) None of these
12. The Declaration of American independence was drafted by
 - (1) George Washington
 - (2) George Masons
 - (3) Thomas Jafferson
 - (4) John Locke
13. Renaissance took place in Europe during the
 - (1) 12th century (2) 10th century
 - (3) 15th century (4) 18th century
14. One of the three stages in the growth of modern democracy is
 - (1) the rule of law.
 - (2) idea of accountability.
 - (3) social and economic equality.
 - (4) None of these
15. Which of the following countries has direct democracy?
 - (1) USA (2) Germany
 - (3) Switzerland (4) India
16. Which of the following is needed for the success of democracy?
 - (1) Casteism (2) Regionalism
 - (3) Linguism (4) Literacy
17. What is/are the main problem or problems India faces?
 - (1) Inequality (2) Poverty
 - (3) Illiteracy (4) All of these
18. When did we have hung parliament for the first time in India?
 - (1) 1988 (2) 1989
 - (3) 1990 (4) 1991
19. The Universal Declaration of Human Rights was adopted by the UN on
 - (1) 10 November 1948
 - (2) 10 December 1948
 - (3) 10 October 1945
 - (4) 10 December 1945
20. Disarmament means
 - (1) the destruction of weapons.
 - (2) the destruction of all weapons.
 - (3) both of the above
 - (4) None of these
21. The social differences based on choices are
 - (1) theism and atheism.
 - (2) selection of education.
 - (3) selection of occupation.
 - (4) All of these
22. The United Kingdom faced the problem of social division due to
 - (1) language diversities.
 - (2) religious division in Ireland.
 - (3) cultural diversities.
 - (4) political alliances.
23. The percentage of Protestants in the United Kingdom is:
 - (1) 40 (2) 44
 - (3) 47 (4) 42
24. The chief feature of democracy is
 - (1) general elections.
 - (2) adult franchise.
 - (3) collective responsibility.
 - (4) more powers to the central government.
25. Which university recently installed the statues of Smith, Carlos and Norman in its campus?
 - (1) The Howard University
 - (2) The Chicago state
 - (3) The Nelson Mandela Metropolitan University
 - (4) San Jose State University
26. People who feel marginalized, deprived and discriminated should fight against injustice by
 - (1) voicing their demands in a peaceful manner.
 - (2) voicing their demands in a constitutional manner.
 - (3) seeking a fair position through elections.
 - (4) all the above mentioned ways.

27. Which two languages are spoken in Belgium?

- (1) French and English
- (2) Dutch and English
- (3) French and Dutch
- (4) Dutch and Sinhala

28. How many times has Belgia amended its constitution?

- (1) Three times (2) Four times
- (3) Twice (4) Five times

29. In a direct democracy

- (1) People govern themselves.
- (2) there are no elections and no representatives.
- (3) Both the above are correct
- (4) None of these

30. Which one of these is not a feature of democracy?

- (1) Rule of people
- (2) Monopoly over people
- (3) Equality and freedom
- (4) Guaranteed rights

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Which of the following statements, reflect how social divisions affect politics?

- (A) Combination of politics and social division is dangerous
- (B) Democracy involves competition among various political parties due to which social divisions get reflected in politics
- (C) All expressions of social divisions in politics lead to disaster
- (D) Social divisions affect voting in most countries
- (E) In a democracy, political parties do not necessarily make policies to redress the grievances disadvantaged communities.
- (F) Political competition along religions and ethnic lines led to disintegration of Yugoslavia into six independent countries.

- (1) ABDF (2) ADEF
- (3) ABDC (4) BCDF

2. When were the Olympics held in Mexico?

- (1) 1968 (2) 1964
- (3) 1972 (4) 1976

3. Descendents of Africans who were sent to USA as slaves are known as

- (1) African Asians.
- (2) American Asians.
- (3) Anglo Indians.
- (4) African Americans.

4. Identify the countries which feel the problem of social division.

- (1) Belgium, Germany and USA
- (2) Belgium, Sri Lanka and UK
- (3) Sri Lanka, Canada and India
- (4) UK, USA and India

5. By which name were American slaves known between 17th and 19th centuries?

- (1) Anglo American (2) Indian American
- (3) African (4) Agro American

6. The International Olympic Association took back the medals of Carlos, Smith and Norman

- (1) for using drugs.
- (2) they were found guilty of violating the Olympic spirit by making a political statement.
- (3) as they were over age.
- (4) as they refused to come to the stage to collect their medals.

7. A society which has similar kinds of people is known as

- (1) a homogeneous society.
- (2) a hetero generous society.
- (3) a divided society.
- (4) None of these.

8. Universal Adult Franchise was introduced in India in the year

- (1) 1947 (2) 1935
- (3) 1950 (4) 1948

9. Which of the following is a feature (characteristic) of democracy?
 - (1) Absence of political rights to all the citizens
 - (2) No freedom of speech and expression
 - (3) One party system
 - (4) Universal Adult Franchise
10. Democracy is a government of the people, by the people and for the people. This definition of democracy was given by
 - (1) Jawaharlal Nehru
 - (2) Abraham Lincoln
 - (3) Dicey
 - (4) First President Washington of USA
11. Transformation of ideas, thoughts and practices of the people is called
 - (1) Revolution
 - (2) Evolution
 - (3) Revolt
 - (4) None of these
12. The hundred year war was fought between
 - (1) France and England
 - (2) France and Germany
 - (3) Germany and Austria
 - (4) England and Australia
13. The war of American independence was fought between
 - (1) North American and South America.
 - (2) Britain and North America.
 - (3) France and America.
 - (4) Canada and South America.
14. Equality, liberty and fraternity as the basis of the modern democratic rule had been the principles from
 - (1) American Revolution.
 - (2) French Revolution.
 - (3) Glorious Revolution.
 - (4) Russian Revolution.
15. Who got credit of giving India the concept of a democratic government?
 - (1) Greeks
 - (2) British
 - (3) French
 - (4) Americans
16. Anyone who shifts from one place to another place for work or economic opportunity is known as a/an
 - (1) immigrant
 - (2) emigrant
 - (3) migrant
 - (4) None of these
17. "All human beings are born free and all are equal in dignity and rights" has been given in the
 - (1) French revolution
 - (2) American revolution
 - (3) Magna Carta
 - (4) Declaration of human rights
18. Which of the following nations do not have one-party system?
 - (1) Myanmar
 - (2) Iran
 - (3) America
 - (4) Zambia
19. Which of the following forms part of civil rights?
 - (1) Right to life and liberty
 - (2) Right to vote and contest in elections
 - (3) Right to work and equal pay for equal work
 - (4) Right to marry
20. The silver medalist, white Australian athlete, Peter Norman, wore a human rights badge on his shirt during the medal ceremony of Mexico Olympics
 - (1) to represent black poverty
 - (2) to support civil rights movement
 - (3) to show his support to the Afro American athletes
 - (4) to show his anger for IOA
21. Martin Luther King was influenced by
 - (1) Mahatma Gandhi
 - (2) Jawaharlal Nehru
 - (3) Rabindranath Tagore
 - (4) None of these
22. The Black Power Movement emerged in
 - (1) 1964
 - (2) 1965
 - (3) 1966
 - (4) 1962
23. Which one of the following has been achieved in India?
 - (1) Social democracy
 - (2) Economic democracy
 - (3) Political democracy
 - (4) None of these
24. For the successful functioning of democracy we need
 - (1) social change.
 - (2) economic development.
 - (3) vigilant public.
 - (4) None of the above
25. Which types of social differences are in Sri Lanka?
 - (1) Linguistic and regional
 - (2) Linguistic and religious
 - (3) Physical appearance and class
 - (4) Caste and tribe

26. Which type of social diversity or division do we find in Belgium?

 - (1) Religious
 - (2) Linguistic
 - (3) Regional
 - (4) Gender

27. How is overlapping different from cross-cutting?

 - (1) In respect of economic condition
 - (2) In respect of domestic or foreign origin
 - (3) Overlapping is related to the Blacks where as cross cutting to the whites
 - (4) Overlapping may create deep social divisions and tensions where as cross cutting is easier to accommodate
28. Catholics and Protestants have had conflicts in

 - (1) Northern Ireland
 - (2) Canada
 - (3) Netherlands
 - (4) Finland

29. Fundamental rights or basic human rights are

 - (1) Guaranteed to individuals/citizens
 - (2) Guaranteed to aliens
 - (3) Guaranteed to all tourists
 - (4) None of these

30. How many people of Belgium speak German language?

 - (1) 3%
 - (2) 4%
 - (3) 5%
 - (4) 1%

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

1. 2	2. 2	3. 2	4. 1	5. 1	6. 2	7. 4	8. 2	9. 4	10. 3
11. 1	12. 3	13. 3	14. 3	15. 1	16. 2	17. 4	18. 3	19. 2	20. 4
21. 4	22. 2	23. 2	24. 3	25. 4	26. 4	27. 3	28. 2	29. 3	30. 2

PRACTICE EXERCISE 2 (B)

1. 1	2. 1	3. 4	4. 2	5. 4	6. 2	7. 1	8. 3	9. 4	10. 2
11. 1	12. 1	13. 2	14. 2	15. 1	16. 3	17. 4	18. 3	19. 1	20. 3
21. 2	22. 3	23. 3	24. 3	25. 2	26. 2	27. 4	28. 1	29. 1	30. 4

Gender, Religion and Caste in Politics

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Name two countries where the participation of women in public life is very high.
(1) Uruguay and Uzbekistan
(2) Norway and Sweden
(3) Chile and Argentina
(4) None of these
2. Which one of the following is a case of sexual discrimination?
(1) Cases of child births are handled by lady doctors only.
(2) Pujaris and Maulvis are males even though religious communities comprise both men and women.
(3) Fighter pilots are mostly males.
(4) There are women in the artillery corps of the army.
3. India is a secular state because
(1) Indian constitution prohibits discrimination based on religion.
(2) there have been Presidents who are Hindus and Muslims.
(3) India's population comprises people of different religious faiths.
(4) the constitution does not discriminate between naturalized citizens and citizens by birth.
4. A society that values man more and gives ruling power to men over women is a
(1) feminist society (2) patriarchal society
(3) socialist society (4) communist society
5. Shift of population from villages to cities is
(1) urbanization (2) ruralization
(3) communalization (4) None of these
6. _____ comprise 80% of the population in India.
(1) Hindus (2) Muslims
(3) Christians (4) Jains
7. Who among the following has said that religion can never be separated from politics?
(1) Acharya Vinobha Bhave
(2) Mahatma Gandhi
(3) Sarojini Naidu
(4) Rajendra Prasad
8. The idea that constitutes one of the foundations of our country is
(1) communalism (2) regionalism
(3) secularism (4) None of these

9. Buddhism is the official religion of
 - (1) Sri Lanka (2) Pakistan
 - (3) Indonesia (4) England
10. Swami Dayanand Saraswati was against the
 - (1) Vedas (2) Upanishads
 - (3) Idol worship (4) Brahman Supremacy
11. The first news paper to be printed was
 - (1) *Times of India* (2) *Kesari*
 - (3) *Bengal Gazette* (4) None of these
12. Radical changes in women's clothing were enabled by
 - (1) the new times.
 - (2) the women's movements.
 - (3) the world wars.
 - (4) the industrial revolution.
13. What is the population of India according to the 2011 census?
 - (1) 1.01billion (2) 1.21billion
 - (3) 1.11billion (4) 1.31billion
14. Which of the following States/Union territories has the lowest sex ratio in India?
 - (1) Kerala (2) Puducherry
 - (3) Delhi (4) Haryana
15. Literacy among women was extremely low in
 - (1) Andhra Pradesh (2) Madhya Pradesh
 - (3) Orissa (4) Bihar
16. The article that provides the right to the minorities to conserve their language and culture is
 - (1) Article 27 (2) Article 28
 - (3) Article 29 (4) Article 30
17. The first linguistic state in the Indian Union is
 - (1) Uttar Pradesh (2) Andhra Pradesh
 - (3) Tamil Nadu (4) Kerala
18. Untouchability has been abolished and its practice is forbidden by
 - (1) Article 14 (2) Article 15
 - (3) Article 16 (4) Article 17
19. The representation of women in the Lok Sabha is
 - (1) 6% (2) 7%
 - (3) 10% (4) 9%
20. The article that prohibits the employment of children in dangerous work is
 - (1) Article 19 (2) Article 21
 - (3) Article 23 (4) Article 24
21. The rate of literacy in Kerala is
 - (1) 93.91% (2) 91.02%
 - (3) 90.05% (4) 91.29%
22. Which one of the following is an Islamic country?
 - (1) Nepal (2) Sri Lanka
 - (3) Japan (4) Pakistan
23. Which one of the following divisions is unique to India?
 - (1) Gender division (2) Caste division
 - (3) Economic division (4) Religious division
24. The official language of India is
 - (1) Telugu (2) English
 - (3) Hindi (4) Both (2) and (4)
25. The article that stipulates that all minorities shall have the right to establish educational institutions of their choice is
 - (1) Article 27 (2) Article 28
 - (3) Article 29 (4) Article 30
26. Who is the founder of the separate state of Pakistan?
 - (1) Mohammad bin-Tughlaq
 - (2) Mohammad Ali Jinnah
 - (3) Kubali Khan
 - (4) None of these
27. Which party promotes the plight of harijans in India?
 - (1) Bahujan Samaj Party
 - (2) Peasants and workers party of India
 - (3) Bharatiya Janata Party
 - (4) Telugu Desam
28. First woman to win Nobel Prize was
 - (1) Kiran Bedi
 - (2) Mrs Chandra Mukhi Das
 - (3) Mother Teresa
 - (4) Mrs Indira Gandhi
29. Zoroastrianism was the religion of ancient
 - (1) China (2) Rome
 - (3) America (4) Persia
30. Which of the following factor often plays decisive role in elections?
 - (1) Education of the candidate
 - (2) Communities
 - (3) Popularity rating of the leaders and government performance
 - (4) Gender

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Literacy rate among women is
 - (1) 52% (2) 58%
 - (3) 54% (4) 56%
2. Women have been provided reservation in
 - (1) Lok Sabha
 - (2) State assemblies
 - (3) Indian administrative services
 - (4) Local bodies
3. Literacy rate among men is
 - (1) 70% (2) 72%
 - (3) 76% (4) 79%
4. One who believes in equal rights and opportunities for women and men is a
 - (1) communist (2) socialist
 - (3) communalist (4) feminist
5. Laws relating to matters related to marriage, divorce, inheritance, etc., are
 - (1) social laws (2) legal laws
 - (3) family laws (4) moral laws
6. Which of the following countries has the lowest participation of women in public life?
 - (1) Sweden (2) Demark
 - (3) Norway (4) South Africa
7. Gender division usually means
 - (1) biological differences between men and women.
 - (2) unequal child sex-ratio.
 - (3) unequal roles assigned by the society to men and women.
 - (4) absence of voting rights for women.
8. The reformers who advocated and worked to establish a society free of caste inequalities were
 - (1) Jyotiba Phule.
 - (2) B. R. Ambedkar and Perijar Ramaswamy Naicker.
 - (3) Gandhiji.
 - (4) All of these
9. Raja Ram Mohan Roy founded the Brahma Samaj in
 - (1) 1828 (2) 1830
 - (3) 1831 (4) 1930
10. The Theosophical society was organized by
 - (1) Dr Annie Besant (2) Sarojini Naidu
 - (3) Madam Blavatski (4) Louis Vivian Derozio
11. The National Women's Suffrage Association was headed by
 - (1) Mrs Station (2) Lucy Stone
 - (3) Amelia Bloomer (4) Elizabeth II
12. The first community to incorporate western styles in dress form in India was
 - (1) Muslims (2) Dalits
 - (3) Parsis (4) Hindus
13. Name the most populated state of India.
 - (1) Andhra Pradesh (2) Uttar Pradesh
 - (3) Madhya Pradesh (4) Karnataka
14. The female literacy rate according to 2011 census is
 - (1) 60.12% (2) 61.21%
 - (3) 64.31% (4) 65.46%
15. India was partitioned into two countries on the basis of
 - (1) race (2) religion
 - (3) language (4) caste
16. Right to Religion in India is a
 - (1) Civil right (2) Political right
 - (3) Economic right (4) Fundamental right
17. The term scheduled caste was first used in the act of
 - (1) 1909 (2) 1919
 - (3) 1935 (4) 1947
18. The scheduled caste in the Indian population constitute
 - (1) 16% (2) 18%
 - (3) 20% (4) 22%
19. In the Indian context, advocacy for a separate state within the country is known as
 - (1) regionalism (2) separatism
 - (3) secessionism (4) nationalism
20. In the Indian context, advocacy of withdrawal from the larger country is known as
 - (1) regionalism (2) separatism
 - (3) secessionism (4) nationalism

21. The national literacy rate in India in 2011 was
 (1) 70.02% (2) 72.08%
 (3) 71.07% (4) 74.04%
22. Caste hierarchy means
 (1) a shift from one occupation to another.
 (2) a ladder-like formation in which the caste groups are placed from the “highest” to the “lowest” castes.
 (3) religious equality.
 (4) communal harmony and peace on the basis of caste.
23. In traditional India, the social status was determined by
 (1) wealth (2) occupation
 (3) caste (4) religion
24. The three essential elements of Indian national life are
 (1) democracy, sovereignty and social justice.
 (2) sovereignty, secularism and socialism.
 (3) socialist and secularism and federalism.
 (4) democracy, secularism and social justice.
25. State with the highest female population as per census is
 (1) Kerala (2) Himachal Pradesh
 (3) Uttar Pradesh (4) Andhra Pradesh
26. Shankaracharya was the founder of
 (1) Buddhism (2) Jainism
 (3) Arya Samaj (4) Advaitic philosophy
27. The first woman Prime Minister of India was
 (1) Mrs Vijayalakshmi Pandit
 (2) Mrs Sonia Gandhi
 (3) Mrs Indira Gandhi
 (4) Mrs Fathima Beevi
28. Confucianism and Taoism were the religions of
 (1) China (2) Russia
 (3) Rome (4) Greece
29. A person who does not discriminate others on the basis of religious beliefs is called
 (1) communalist
 (2) secularist
 (3) casteist
 (4) feminist
30. Which one of the following is not a case of communalism?
 (1) Religion is taken as the basis of the nation.
 (2) When one religion is discriminated against other.
 (3) State has no official religion.
 (4) Demands of one religious group are formed in opposition to another.

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 2 | 3. 1 | 4. 2 | 5. 1 | 6. 1 | 7. 2 | 8. 3 | 9. 1 | 10. 3 |
| 11. 3 | 12. 3 | 13. 2 | 14. 3 | 15. 4 | 16. 3 | 17. 2 | 18. 4 | 19. 3 | 20. 4 |
| 21. 1 | 22. 4 | 23. 2 | 24. 4 | 25. 4 | 26. 2 | 27. 1 | 28. 3 | 29. 4 | 30. 3 |

PRACTICE EXERCISE 3 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 3 | 4. 4 | 5. 3 | 6. 4 | 7. 3 | 8. 4 | 9. 1 | 10. 3 |
| 11. 1 | 12. 3 | 13. 2 | 14. 4 | 15. 2 | 16. 4 | 17. 3 | 18. 3 | 19. 2 | 20. 3 |
| 21. 4 | 22. 2 | 23. 3 | 24. 4 | 25. 4 | 26. 4 | 27. 3 | 28. 1 | 29. 2 | 30. 3 |

Popular Struggles, Movements and Political Parties

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Nepal witnessed an extraordinary popular movement in April 2006. The movement was aimed
 - (1) to restore democracy.
 - (2) to protect environment.
 - (3) to dismiss the king.
 - (4) to restore Marxist rule.
2. Which one of these following kings was killed in mysterious massacre of the royal family in 2001?
 - (1) King Raj Bahadur
 - (2) King Birendra
 - (3) King Gyanendra
 - (4) None of these
3. What was the important reason of Bolivia's Water War?
 - (1) Decrease in water supply by the MNC
 - (2) Increase in the price of water by the Government
 - (3) Privatization of water
 - (4) Pressure of World Bank to release water
4. Groups which try to influence government policies are known as
 - (1) Movement groups
 - (2) Pressure groups
 - (3) Sectional groups
 - (4) Interest groups
5. Where is Bolivia situated?
 - (1) Latin America
 - (2) North America
 - (3) Europe
 - (4) Africa
6. Organization which are formed to promote their interest are known as
 - (1) sectional groups
 - (2) movement groups
 - (3) interest groups
 - (4) movements
7. What was FEDECOR?
 - (1) It was a political party of Bolivia.
 - (2) It was a group of parties of Bolivia.
 - (3) It was an organization comprised of local professional, including engineers and environmentalists belonging to Bolivia.
 - (4) It was an alliance of the people.
8. Who among the following personalities is actively involved in the Narmada Bachao Andolan?
 - (1) Medha Patkar
 - (2) Vandana Shiva
 - (3) Sundarlal Bahuguna
 - (4) Baba Amte

9. Which of the political party is born out of a movement?
 - (1) Akali Dal
 - (2) Asom Gana Parishad
 - (3) Bahujan Samajwadi Party
 - (4) All of these
10. Vande Mataram movement was launched as a result of
 - (1) Growth of self-respect of Indians
 - (2) Indian desire to start swadeshi movement
 - (3) The partition of Bengal
 - (4) None of these
11. Freedom fighter Capt Lakshmi Sehgal who passed away on 23-7-2012 was associated with _____ in the freedom struggle.
 - (1) Mahatma Gandhi
 - (2) Subhash Chandra Bose
 - (3) Bhagat Singh
 - (4) Jawaharlal Nehru
12. Which of the following are the characteristics of institutional monarchy?
 - (1) An elected representative acts as the head of the state.
 - (2) The king is the leader of Parliament
 - (3) If the Monarch is the head of the state, he plays only the symbolic role.
 - (4) None of these
13. Which one of these takes part in elections?
 - (1) Interest group (2) Religious group
 - (3) Political Party (4) Movement group
14. Multi-party system advocates
 - (1) the political parties which govern the country.
 - (2) the government is forced by various parties coming together.
 - (3) does not permit free competition for power.
 - (4) this system allows a variety of interests and opinions to enjoy political representations
15. Which of the following law says if any MLA or MP changes parties, he or she will lose the seat in the legislatures is
 - (1) Anti-Defection law (2) Anti-Criminal law
 - (3) Anti-Movement law (4) None of these
16. In India, the candidates for contesting elections are chosen by the
 - (1) voters
 - (2) top party leaders
 - (3) respective communities.
 - (4) ruling party.
17. What is By election?
 - (1) Election held to fill a vacancy caused by the death or any reason
 - (2) Election held after a specific period.
 - (3) Elections held to form the new government.
 - (4) Elections held in between the fixed term of the house.
18. Organizations that seek to promote the interests of a particular section or group.
 - (1) Movement (2) Political parties
 - (3) Sectional parties (4) Public interest groups
19. Organizations that mobilize people with a view to win political power
 - (1) Movement (2) Revolutions
 - (3) Political parties (4) Public interest groups
20. Which of the following countries has adopted multi-party system?
 - (1) India (2) China
 - (3) United States (4) United Kingdom
21. System with one party is known as
 - (1) Uni party system (2) Multi party system
 - (3) Bi party system (4) None of these
22. Which of the following government is ruling at the centre?
 - (1) Bharatiya Janata Party
 - (2) Congress Party
 - (3) Bahujan Samaj Party
 - (4) Janata Party
23. Bharatiya Janata Party was founded in the year
 - (1) 1979 (2) 1980
 - (3) 1981 (4) 1982
24. What is the guiding philosophy of the Bharatiya Janata Party?
 - (1) Bahujan Samaj
 - (2) Revolutionary democracy
 - (3) Integral Humanism
 - (4) Modernity
25. Who among the following is the president of the Bharatiya Janata Party at present?
 - (1) Shri Rajanath Singh (2) Shri L.K. Advani
 - (3) Shri Nitin Gadkari (4) Shri Atal Bihari Vajpai

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Identify the element which is not shared both by the movement in Nepal and the struggle in Bolivia.
 - (1) A political conflict that led to popular struggle
 - (2) The struggle involved mass mobilization
 - (3) It was about the foundations of the country's politics
 - (4) It involved critical role of political organizations
2. Who among the following was the last king of Nepal?
 - (1) King Birendra (2) King Raj Bahadur
 - (3) King Vir Pratap (4) King Gyanendra
3. Which one of the following is not resorted to by business groups?
 - (1) Employing professional lobbyists
 - (2) Disrupting public transport system
 - (3) Sponsor advertisements in newspaper
 - (4) Submit memorandums
4. The city of Cochabamba is related to which issue?
 - (1) Nepal's Popular Struggle
 - (2) Narmada Bachao Andolana
 - (3) Environmental Movement
 - (4) Bolivia's Water War
5. Democracy can be evolved through
 - (1) Popular struggles
 - (2) Mass mobilization
 - (3) New political organizations
 - (4) All of these
6. What was common in both the struggle in Nepal and Bolivia?
 - (1) In both the cases struggle involved mass mobilization
 - (2) In both the cases people used violence
 - (3) In both the cases the demands of people were not fulfilled
 - (4) In both the cases government ignored the people
7. Which one of the following dams was associated with Narmada Bachao Andolan?
 - (1) The Bhakra Dam
 - (2) The Sardar Sarovar Dam
 - (3) The Hirakud Dam
 - (4) The Kosi Dam
8. In Bolivia, the protest was organized by the
 - (1) Communist Party
 - (2) Trinamool Congress
 - (3) Seven Party Alliance
 - (4) FEDECOR
9. Democracy was restored in Nepal in the year
 - (1) 1989 (2) 1991
 - (3) 1990 (4) 1993
10. Sunderlal Bahuguna, a prominent social activist is associated with one of the following movements?
 - (1) Chipko Movement
 - (2) Anti-corruption movement
 - (3) Save Democracy Movement
 - (4) Narmada Bachao Andolan
11. Groups which try to influence government policies are known as
 - (1) movements groups (2) pressure groups
 - (3) sectional groups (4) interest groups
12. Narmada Bachao Andolan is a good example of
 - (1) Interest group (2) Religious group
 - (3) Political Party (4) Movement group
13. Partisan means
 - (1) Party which runs the government.
 - (2) Affair of the state or the science of government.
 - (3) A person who is strongly committed to a party.
 - (4) A group of people who come together to promote common beliefs.
14. Which one of the following is not a characteristic feature of a political party?
 - (1) It has certain organization
 - (2) It has a unity of purpose
 - (3) It adheres of constitutional means
 - (4) It does not fulfil its politics when voted to power
15. Which of the following is not a function of political parties?
 - (1) Parties contest elections
 - (2) Parties do not shape public opinion

- (3) Parties put forward different policies and programmes
(4) Parties play a decisive role in making laws for the country.
- 16.** Coalition government is a
(1) government of more than two political parties in case no single party gets the majority
(2) government of two political parties
(3) government of two or more regional parties
(4) government of two or more national parties
- 17.** What are mid-term elections?
(1) Elections held to fill a vacancy caused by any reason
(2) Elections held before the expiry of the full term of any House
(3) Elections held after the expiry of the full term of any house
(4) None of these
- 18.** Struggles launched for the resolution of a social problem with or without an organizational structure.
(1) Public interest groups
(2) Political parties
(3) Movement
(4) Sectional interest groups
- 19.** Every party in India has to register itself with
(1) the president.
(2) the parliament.
(3) the election commission.
(4) the police.
- 20.** How many parties are registered with the election commission of India?
(1) 100 (2) 200
(3) 300 (4) 750
- 21.** A group of people who come close to each other to attain their common aim of power is known as
(1) Political party (2) Interest group
(3) Political leadership (4) Factional group
- 22.** How do political parties form and run the government?
(1) Political parties elect its leaders
(2) Political parties, sometimes ruminate their officials
(3) The political party which wins majority of the seats in the elections is invited to form the government
(4) Political parties launch movements for the resolution of problems faced by the people.
- 23.** Which is one of the oldest parties in the world?
(1) Indian National Congress (INC)
(2) Communist Party of India (CPI)
(3) Bhartiya Janata Party (BJP)
(4) Bahujan Samaj Party (BSP)
- 24.** Who is the President of the Congress Party at present?
(1) Sonia Gandhi
(2) Sharad Pawar
(3) Manmohan Singh
(4) Varun Gandhi
- 25.** National conference is a party associated with
(1) Punjab (2) Jammu & Kashmir
(3) Bihar (4) Maharashtra

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 3 | 4. 2 | 5. 1 | 6. 3 | 7. 3 | 8. 1 | 9. 2 | 10. 3 |
| 11. 2 | 12. 1 | 13. 3 | 14. 4 | 15. 1 | 16. 2 | 17. 1 | 18. 3 | 19. 3 | 20. 1 |
| 21. 1 | 22. 2 | 23. 2 | 24. 3 | 25. 3 | | | | | |

PRACTICE EXERCISE 4 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 2 | 4. 2 | 5. 4 | 6. 1 | 7. 2 | 8. 4 | 9. 3 | 10. 1 |
| 11. 2 | 12. 2 | 13. 3 | 14. 4 | 15. 4 | 16. 1 | 17. 2 | 18. 3 | 19. 3 | 20. 4 |
| 21. 1 | 22. 3 | 23. 1 | 24. 1 | 25. 2 | | | | | |

Outcomes of Democracy, Challenges to Democracy

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 24: Select the correct alternative from the given choices.

1. Name the personality associated with the popular definition of democracy.
(1) Jawaharlal Nehru (2) Mahatma Gandhi
(3) Abraham Lincon (4) Karl Marx
2. The principle of Universal adult suffrage was incorporated in which article of the constitution?
(1) Article 356 (2) Article 1
(3) Article 5 (4) Article 326
3. The word 'democracy' was derived from which language?
(1) Greek (2) Latin
(3) English (4) French
4. Which of the following are elected by indirect election?
(1) Members of House of States
(2) Members of House of People
(3) Members of legislative assembly
(4) Both (1) and (3)
5. A person who was not eligible to vote in 1937 provincial elections could cast his vote in 1952 General elections. Identify the person from the following.
(1) Thomas who was 19 year old and was not educated.
(2) Kumar who was 22 year old and was a graduate.
(3) Basu who was 24 year old and not educated.
(4) Both (1) and (4)
6. Which of the following amendments reduced the voting age from 21 to 18 for General elections?
(1) 42nd amendment
(2) 73rd amendment
(3) 61st amendment
(4) 54th amendment
7. A person is registered as a voter in a constituency. But he is not eligible to contest for Lok Sabha or assembly election. Identify the person.
(1) A person who is 30 year old and is a postgraduate
(2) A person who is 50 year old and not a graduate
(3) A person who is 20 year old and is a graduate
(4) A woman who is 28 year old and is a graduate

8. Which of the following statements regarding Rajya Sabha are wrong?
 - (1) It is also called House of States
 - (2) Members are elected by Universal adult franchise
 - (3) It is a permanent house
 - (4) None of these
9. Identify the year of first General elections held in India with universal adult franchise.

(1) 1947	(2) 1950
(3) 1956	(4) 1952
10. How many times mid term elections were held for Lok Sabha till now?

(1) 2	(2) 3
(3) 4	(4) 5
11. What is the maximum permissible strength of elected representatives for Lok Sabha according to the Constitution?

(1) 550	(2) 552
(3) 545	(4) 543
12. Name the Prime minister whose election was disqualified on the grounds of electoral malpractices.
 - (1) Mr Rajiv Gandhi
 - (2) Mrs Indira Gandhi
 - (3) Mr P.V. Narasimha Rao
 - (4) Charan Singh
13. Arrange the following events relating to the election process in correct chronological order.
 - (A) Announcing the schedule of elections
 - (B) Preparation of final list of contestants
 - (C) Filing of nominations
 - (D) Withdrawal of nominations
 - (E) Allotment of symbols to the contestants

(1) ACDEB	(2) ACD BE
(3) CDBEA	(4) CDEBA
14. Electorate to which of the following statutory bodies requires minimum educational qualification as a prerequisite?
 - (1) Legislative assembly
 - (2) Municipal Corporation
 - (3) Legislative council
 - (4) Upper House
15. What is the maximum term of office for a person who is elected as a member of Rajya Sabha?
 - (1) 5 years
 - (2) 6 years
 - (3) 3 years
 - (4) No fixed term
16. Which statutory body is entrusted with the responsibility of preparing the electoral list?
 - (1) Election Commission
 - (2) Planning Commission
 - (3) Assembly
 - (4) Parliament
17. Electoral college for the election of the president constitutes
 - (1) all members of legislative assemblies and both the houses of parliament
 - (2) elected members of legislative assemblies and both the houses of parliament
 - (3) elected members of legislative assemblies
 - (4) elected members of both the houses of parliament
18. The number of nominated members to Lok Sabha and Rajya Sabha respectively are

(1) 12, 12	(2) 2, 2
(3) 2, 12	(4) variable
19. The Indian Constitution replaced which of the following acts which was in force till 1950?
 - (1) Government of India Act, 1935
 - (2) Government of India Act, 1919
 - (3) India Councils Act, 1909
 - (4) India Councils Act, 1892
20. Mrs Rajitha is eligible to contest for Lok Sabha but not eligible for contesting for membership in Rajya Sabha. Identify the probable reason.
 - (1) She is a woman candidate
 - (2) She might be holding an office of profit
 - (3) She might not have completed 30 years age
 - (4) She might have already served as the member of Rajya Sabha once
21. Which of the following similarities between Lok Sabha and Rajya Sabha false?
 - (1) The eligibility conditions are same for both houses
 - (2) The members of both houses have the same tenure in both houses
 - (3) The members of both houses can participate in presidential election
 - (4) None of these

22. The persons who were coming in the age group of 18-21 became eligible for voting for which of the following Lok Sabha elections?

- (1) 7th Lok Sabha (2) 8th Lok Sabha
(3) 9th Lok Sabha (4) 10th Lok Sabha

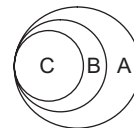
23. Which of the following persons are eligible for membership in Rajya Sabha in 2013?

- (1) Murali born in 1978
(2) Jyothi born in 1988
(3) Pradeep born in 1976
(4) Both (1) and (3)

24. Ms Sangeeta was born in 1987 she was eligible for which of the following as far as 2011 general elections were concerned?

- (1) Inclusion in electoral list
(2) Filing nomination for contesting for assembly constituency
(3) filing nomination for contesting for Lok Sabha constituency
(4) All the above

Directions for question 25: The given Venn diagram represents voters, contestants for lower house and upper house for the forthcoming 2014 general elections. Based on the above Venn diagram, answer the following question.



25. Identify the true statements among the following on the basis of the diagram.

- (A) Region 'A' represents people born between 1989-1996
(B) Region 'C' represents people who crossed 35 years age.
(C) People coming under both B and C can contest for both houses of parliament.
(D) People coming under 'A' can contest for only Lok Sabha in 2019 general elections.
- (1) B, C (2) A, B
(3) A, D (4) B, D

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 24: Select the correct alternative from the given choices.

1. Which of the following persons were given voting rights in British India in 1937 elections?

- (A) Raj who was 28 years old and not educated.
(B) Ram who was 25 years old and is a graduate.
(C) Sita who was 21 years old and is a tax payer.
(D) John who was 27 years old and is not educated.
(E) Mary who was 25 years old and is not educated.

- (1) Ram, Sita and John (2) Ram, John
(3) Ram only (4) All of the above

2. In which year were the last elections held in British India?

- (1) 1945 (2) 1937
(3) 1942 (4) 1939

3. The year 1892 was associated with which of the following significant events as far as elections in India are concerned?

- (1) Implementation of universal adult franchise in the elections

- (2) First elections to provincial councils
(3) First elections to legislative councils
(4) Both (2) and (3)

4. Mention the year of introduction of electoral principle in India.

- (1) 1872 (2) 1884
(3) 1892 (4) 1909

5. An election was held in 1969. The member in a constituency resigned in 1971. Election for that constituency was held within 6 months. What is that election called?

- (1) General election (2) By election
(3) Mid-term election (4) No Name

6. Who among the following persons are eligible to contest in Lok Sabha election?

- (A) A person who is graduate and 20 year old
(B) A person who is not educated and 21 year old
(C) A person who is graduate and 27 year old
(D) A person who is not educated and 28 year old

- (1) B, C, D (2) C, D
(3) A, C (4) C only

7. Which of the following is not a function of the election commission?
 - (1) Preparation of electoral rolls
 - (2) Revision of electoral rolls
 - (3) Making schedule for elections
 - (4) Selection of candidates for contesting in election
8. Which among the following is not the function of 'Returning officer'?
 - (1) Scrutinising the nomination papers of the contestants
 - (2) Preparation of ballot papers with the allotted symbols for the contestants
 - (3) Allotment of symbols for the contesting candidates
 - (4) Protecting the electoral booths against malpractices
9. How many General elections had been held so far?

(1) 13	(2) 14
(3) 15	(4) 16
10. Name the statutory body which is entitled to lay down the procedure for elections.
 - (1) Election Commission
 - (2) Parliament
 - (3) Electoral college
 - (4) President
11. In case of electoral malpractice, who has the power to declare the election of the member invalid?
 - (1) Chief Election Commissioner
 - (2) Returning Officer
 - (3) Supreme Court
 - (4) Supreme Court or High Court
12. What is the mark present on the seal which voter has to affix against the name of the contestant?

(1) Swastika	(2) Ashoka Chakra
(3) Three lions	(4) None of these
13. Till 1990, a person was eligible to vote for Panchayat elections and not eligible to vote for Lok Sabha election. What would be the reason?
 - (1) The person may not have registered his name in the electorate
 - (2) The age limit for voting was different for local body and parliament elections
 - (3) The person might not have required educational qualification
 - (4) The person might be residing in a state other than his native state
14. Why is Rajya Sabha called the House of States?
 - (1) Electoral college constitutes only the representatives of state assemblies
 - (2) Rajya Sabha consists of members of legislative assemblies as its members
 - (3) Rajya Sabha elections are held along with the elections to state assemblies
 - (4) Rajya Sabha is meant to protect the interests of States in the federal set up.
15. What is envisaged in the Representation of People's Act?
 - (1) The procedure for elections
 - (2) The lists of registered voters in each constituency
 - (3) The list of recognized political parties
 - (4) All of these
16. Electoral college for the election of members for Upper House is constituted by
 - (1) the members of parliament and the members of state legislatures
 - (2) the elected members of state legislative assemblies
 - (3) the members of parliament
 - (4) the members of legislative assemblies and legislative councils
17. A person Ajith is elected as a member of Rajya Sabha in 2009 and his tenure lasts till

(1) 2015	(2) 2014
(3) 2013	(4) 2016
18. The strength of elected members in the present Lok Sabha is

(1) 552	(2) 550
(3) 545	(4) 543
19. What is the maximum permissible strength of elected members of Upper House according to the Constitution?

(1) 234	(2) 238
(3) 242	(4) 250
20. Which of the following statements regarding the election of members of Upper House is false?
 - (1) For every 2 years, $\frac{1}{3}$ rd of the members retire
 - (2) The member of Rajya Sabha can hold the office for a period of 5 years
 - (3) The members are elected by indirect election
 - (4) The members enjoy the same privileges as the members of Lok Sabha

21. What is the year associated with the reduction of age limit from 21 to 18 in India?

- (1) 1994 (2) 1989
(3) 1984 (4) 1999

22. Years of birth of some persons are given below. Identify the persons who become eligible for contesting in Lok Sabha election in 2014?

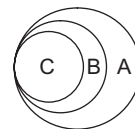
- (A) 1996 (B) 1990
(C) 1989 (D) 1994
(E) 1992
(1) A, B, D (2) B, C
(3) B, C, E (4) B, C, D, E

23. Which of the following statements regarding electoral list for general elections for Lok Sabha is false?

- (1) The persons who were born before 1934 were included for 1952 elections
(2) The persons who were born before 1936 were included for 1957 elections
(3) The persons who were born before 1996 will be included for 2014 elections
(4) None of these

Directions for question 24: The given Venn diagram represents voters, contestants for lower house and upper house

for the forthcoming 2014 general elections. Based on the above Venn diagram, answer the following question.



24. The region B' represents which of the following persons?

- (1) All the people born between 1989-1992
(2) All the people born between 1979-1989
(3) All the people born between 1969-1979
(4) All of them

25. Mr Rajeev was born in 1962, which of the following facts were correct regarding his participation in elections?

- (1) He was eligible to vote for municipal elections held in 1980.
(2) He was eligible to vote for Lok Sabha elections held in 1980.
(3) He was not eligible to vote for any election up to 1982.
(4) He was eligible to vote for both the elections held in 1980.

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

1. 3	2. 4	3. 1	4. 1	5. 3	6. 3	7. 3	8. 2	9. 4	10. 4
11. 1	12. 2	13. 1	14. 3	15. 2	16. 1	17. 2	18. 3	19. 1	20. 2
21. 3	22. 1	23. 1	24. 2	25. 2					

PRACTICE EXERCISE 5 (B)

1. 3	2. 2	3. 2	4. 2	5. 2	6. 3	7. 4	8. 3	9. 3	10. 2
11. 4	12. 1	13. 2	14. 4	15. 1	16. 2	17. 1	18. 4	19. 4	20. 2
21. 3	22. 2	23. 1	24. 1	25. 1					

India, United Nations and World Problems

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Who among the following set the tone and tenor of India's foreign policy?
 - (1) Jawaharlal Nehru (2) Indira Gandhi
 - (3) Rajiv Gandhi (4) Lal Bahadur Shastri
2. In which of the following years did India and China enter a war over the border issue in the year?
 - (1) 1960 (2) 1962
 - (3) 1964 (4) 1966
3. In which year did India conduct its first nuclear explosion?
 - (1) 1972 (2) 1973
 - (3) 1974 (4) 1973
4. Which of the following two countries are the largest democracies in the world?
 - (1) India and China (2) America and Britain
 - (3) America and Russia (4) America and India
5. Which of the following year did the Soviet Union disintegrate?
 - (1) 1990 (2) 1991
 - (3) 1992 (4) 1993
6. Pakistan and India went to war over Bangladesh issue in the year
 - (1) 1948 (2) 1965
 - (3) 1971 (4) 1975
7. SAARC was launched in 1985 at the
 - (1) New Delhi Summit (2) Dhaka Summit
 - (3) Cairo Summit (4) Colombo Summit
8. Which of the following is the legislative organ of the UNO?
 - (1) General Assembly
 - (2) Security Council
 - (3) Economic and Social Council
 - (4) Trusteeship Council
9. Which of the following is the judicial organ of the UNO?
 - (1) General Assembly
 - (2) Security Council
 - (3) Secretariat
 - (4) International Court of Justice

10. The main function of the trusteeship council is
 - (1) administering the trust territories.
 - (2) administering the specialized agencies.
 - (3) looking after the children affected by war.
 - (4) promoting the welfare of workers.
11. The headquarters of the International court of Justice are in the city of
 - (1) New York
 - (2) The Hague
 - (3) Geneva
 - (4) Rome
12. Which of the following year did the II World War start?
 - (1) 1919
 - (2) 1929
 - (3) 1939
 - (4) 1949
13. The judges of the International court are elected by
 - (1) General Assembly.
 - (2) Security Council.
 - (3) General Assembly and Security Council.
 - (4) Trusteeship Council.
14. The activities of the specialized agencies of the UNO are co-ordinated by
 - (1) General Assembly.
 - (2) Security Council.
 - (3) Economic and Social Council.
 - (4) Trusteeship Council.
15. United Nations Charter was signed at the _____ meeting?
 - (1) California
 - (2) San Francisco
 - (3) North Carolina
 - (4) Alabama
16. Who among the following is the present Secretary General of the United Nation?
 - (1) Kofi Annan
 - (2) Boutros Boutros Ghali
 - (3) Ban-Ki Moon
 - (4) Perez-de-cuellar
17. Which of the following is the administrative organ of the UNO?
 - (1) General Assembly
 - (2) Security Council
 - (3) Secretariat
 - (4) International Court of Justice
18. Which of the following is the Head quarters of New International Economic Order?
 - (1) Geneva
 - (2) Algiers
 - (3) New York
 - (4) The Hague
19. Disarmament means
 - (1) the destruction of arms
 - (2) the destruction of all weapons
 - (3) Both 1 and 2
 - (4) None of these
20. The Chinese Prime Minister visited India in 1954 and signed on
 - (1) Non-Alignment
 - (2) Panchsheel Pact
 - (3) Human Rights Declaration
 - (4) None of these
21. How many articles are there in the constitution to express the rights?
 - (1) The Universal Declaration of human rights consists of 32 rights.
 - (2) The Universal Declaration of human rights consists of 30 rights.
 - (3) The Universal Declaration of human rights consists of 42 rights.
 - (4) None of these.
22. The permanent member of the Security Council have the exclusive right of
 - (1) veto Power.
 - (2) emergency declaration.
 - (3) military cooperation.
 - (4) None of these.
23. Marshall Plan was intended to help
 - (1) East European States
 - (2) West European States
 - (3) All European States
 - (4) Friendly States
24. The Bandung Conference was an
 - (1) Indo-American Conference.
 - (2) Anglo-Italian Conference.
 - (3) Russo-Japanese Conference.
 - (4) Asian African Conference.
25. The idea of 'Third World' gained importance since
 - (1) 1940
 - (2) 1955
 - (3) 1960
 - (4) 1970

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following were the two super powers in the world up to 1991?
 - (1) America and China
 - (2) Russia and China
 - (3) America and Russia
 - (4) Britain and France
2. Which of the following country took objection to India's intervention in Bangladesh crisis in 1971?
 - (1) America
 - (2) Russia
 - (3) China
 - (4) Britain
3. The largest trading partner of India is
 - (1) Russia
 - (2) China
 - (3) America
 - (4) Britain
4. The Indo-Soviet treaty was signed in the year
 - (1) 1970
 - (2) 1972
 - (3) 1971
 - (4) 1973
5. India had to go to war with Pakistan
 - (1) two times
 - (2) three times
 - (3) four times
 - (4) five times
6. Which of the following are centres of ancient civilization?
 - (1) India and China
 - (2) America and Russia
 - (3) Russia and China
 - (4) America and India
7. The head quarters of the UNO are located at
 - (1) London
 - (2) Paris
 - (3) New York
 - (4) Moscow
8. Which of the following is the executive organ of the UNO?
 - (1) General Assembly
 - (2) Security Council
 - (3) Secretariat
 - (4) Economic and Social Contract
9. How many countries at present are the member countries of the UNO?
 - (1) 185
 - (2) 186
 - (3) 187
 - (4) 193
10. World Health Day is celebrated every year on
 - (1) 7 September
 - (2) 7 November
 - (3) 7 April
 - (4) 7 October
11. Which of the following year did the I World War start?
 - (1) 1914
 - (2) 1918
 - (3) 1922
 - (4) 1926
12. The principal organs of UNO are
 - (1) 4
 - (2) 6
 - (3) 5
 - (4) 8
13. India was a member of the Security Council during
 - (1) 1990–91
 - (2) 1991–92
 - (3) 1992–93
 - (4) 1993–94
14. NPT stands for
 - (1) Nuclear Proliferation Treaty
 - (2) Non-Proliferation Treaty
 - (3) Non-Progressive Treaty
 - (4) None of these
15. The term of a judge in the International Court of Justice is for
 - (1) nine years
 - (2) five years
 - (2) four years
 - (4) eight years
16. The United Nations General Assembly approved the Universal Declaration of Human Rights on
 - (1) 10 December, 1948
 - (2) 10 November, 1948
 - (3) 10 October, 1948
 - (4) 10 August, 1948
17. The International Court of Justice consists of
 - (1) 10 judges
 - (2) 15 judges
 - (3) 12 judges
 - (4) 9 judges
18. Shimla Agreement was signed between India and Pakistan on
 - (1) 13 July 1972
 - (2) 03 July 1972
 - (3) 30 July 1972
 - (4) 31 July 1972
19. Which of the following countries is not a permanent member of the UNO Security Council?
 - (1) USA
 - (2) USSR
 - (3) India
 - (4) UK

20. The line that demarcates India and _____ is the MacMohan line.
 (1) China
 (2) Bangladesh
 (3) Pakistan
 (4) Sri Lanka
21. There has been a dispute between India and Bangladesh
 (1) regarding sharing of Ganga water at Farakka.
 (2) for diversion of Ganga water to save the Kolkata Port.
 (3) to save the Kolkata Port on R. Hooghly.
 (4) All of these
22. Which of the following was the reason for the cold war between USA and the USSR?
 (1) Economic differences
 (2) Political differences
 (3) Ideological differences
 (4) All of these.
23. The main aim of N.A.T.O. was
 (1) to spread socialism in western countries.
 (2) to stop the spread of communism.
 (3) to help the far east countries.
 (4) to assist UNO in establishing world peace.
24. 'Panchasheela' was concerned with
 (1) Tibet and Nepal
 (2) Japan and China
 (3) Sri Lanka and Nepal
 (4) India and Japan
25. The non-permanent members of the Security Council are elected for a term of _____ years.
 (1) 2 (2) 3
 (3) 4 (4) 5

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 3 | 3. 3 | 4. 4 | 5. 2 | 6. 3 | 7. 2 | 8. 1 | 9. 4 | 10. 1 |
| 11. 2 | 12. 3 | 13. 3 | 14. 3 | 15. 2 | 16. 3 | 17. 4 | 18. 2 | 19. 3 | 20. 2 |
| 21. 2 | 22. 1 | 23. 3 | 24. 4 | 25. 2 | | | | | |

PRACTICE EXERCISE 6 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 4 | 4. 3 | 5. 2 | 6. 1 | 7. 3 | 8. 2 | 9. 4 | 10. 3 |
| 11. 1 | 12. 2 | 13. 2 | 14. 2 | 15. 1 | 16. 1 | 17. 2 | 18. 2 | 19. 3 | 20. 1 |
| 21. 4 | 22. 3 | 23. 2 | 24. 4 | 25. 2 | | | | | |

Government at the State and Central Levels

PRACTICE EXERCISE 7 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. A person is eligible to be a member of Lok Sabha, but he is not eligible to contest for President. What could be the reason?
 - (1) The person may be in Government service
 - (2) The person may have dual citizenship
 - (3) The person may have the age between 25 years and 35 years age
 - (4) The person may not have enrolled in electoral list in any constituency
2. Mr Pranab Mukherjee sworn in as President in July 2012. Till when he will be in service as President?
 - (1) July 2016
 - (2) July 2019
 - (3) July 2018
 - (4) July 2017
3. On what ground, can the impeachment motion be moved against the President?
 - (1) Violation of constitution
 - (2) Proved Violation of Constitution
 - (3) Corruption charges
 - (4) All the above
4. How many members of Lok Sabha were eligible to vote in Presidential elections held in July 2012?
 - (1) 550
 - (2) 544
 - (3) 547
 - (4) 542
5. The person holding the office of President enjoys certain privileges. Which of the following does not come under the privilege of President?
 - (1) Protection from arrest on any ground
 - (2) Exemption from answerability in any court of law
 - (3) Protection from impeachment on any ground
 - (4) Both (1) and (3)
6. Which of the following steps is not included in the procedure regarding the money bills?
 - (1) Prior approval by President before introduction in the House
 - (2) Introduction in the Lower House
 - (3) Passing of bill in the Upper House
 - (4) Return of bill by President for reconsideration
7. Who is the ex-officio chairman of the parliamentary sub-committees?
 - (1) President
 - (2) Vice President
 - (3) Prime Minister
 - (4) Speaker

8. Which of the following statements regarding removal of President are wrong?
 - (1) The impeachment motion should be introduced in Lok Sabha only
 - (2) $\frac{1}{4}$ th of the total members should propose the allegation
 - (3) The motion has to be passed by $\frac{2}{3}$ rd of the total members of the House
 - (4) The motion should be taken for discussion only after 14 days of introduction.
9. A Lok Sabha session was conducted in June 2012. What should be the latest date of conduction of next Lok Sabha session according to the constitutional provisions?
 - (1) January 2013
 - (2) October 2012
 - (3) September 2012
 - (4) December 2012
10. Who has the power to increase the number of judges in the Supreme Court?
 - (1) Lok Sabha
 - (2) Rajya Sabha
 - (3) President
 - (4) Parliament
11. What is the maximum strength of elected representatives for Lok Sabha according to the Constitution?
 - (1) 550
 - (2) 552
 - (3) 545
 - (4) 543
12. Which of the following cases can be directly taken by Supreme Court by appeal in the normal course?
 - (1) All criminal cases where High court rejects to give certificate of appeal
 - (2) Criminal cases where death punishment or 10 years imprisonment have been given
 - (3) Civil cases with special leave for appeal
 - (4) Criminal cases with special leave for appeal
13. Arrange the following steps relating to the making of an Act by Parliament in case of money bills in correct chronological order.
 - (A) Introduction in Lok Sabha
 - (B) Discussion in Upper House
 - (C) Discussion in Lower House
 - (D) Approval by President
 - (E) Assent by President
 - (1) DACBE
 - (2) ACD BE
 - (3) DABCE
 - (4) ADCBE
14. Identify the state with maximum number of constituencies for Lok Sabha.
 - (1) West Bengal
 - (2) Maharashtra
 - (3) Uttar Pradesh
 - (4) Bihar
15. Just as President is the Head of the Nation, Governor is the Head of the State. Regarding which of the following matters there is a difference between governor and president?
 - (1) Mode of appointment and removal
 - (2) Power to nominate members to the respective Houses
 - (3) Power to address joint session of two Houses
 - (4) Power to promulgate ordinances
16. Which of the following states have bicameral legislature?
 - (1) Madhya Pradesh
 - (2) Bihar
 - (3) Maharashtra
 - (4) All the above
17. What is the time period which the upper house can withhold an ordinary bill?
 - (1) 60 days
 - (2) 14 days
 - (3) 90 days
 - (4) 30 days
18. A bill is sent for reconsideration to Lower House from Upper House and Lower House has sent it back. Now how long can Upper House withhold the bill for the second time?
 - (1) 1 month
 - (2) 3 months
 - (3) 2 months
 - (4) 14 days
19. The Vidhan Parishad has 78 members. What should be the number of members elected by Graduates?
 - (1) 7 members
 - (2) 12 members
 - (3) 21 members
 - (4) 31 members
20. What should be the maximum permissible strength of the legislative council of Uttar Pradesh if the strength of legislative assembly of the state is 402?
 - (1) 402
 - (2) 201
 - (3) 134
 - (4) Does not depend on the strength of legislative assembly
21. Which of the following judicial powers is not vested with the Governor?
 - (1) Appointment of judges of High court
 - (2) Removal of judges of High court
 - (3) Granting pardon to accused in case of death sentence
 - (4) None of these

22. Which of the following courts is vested with the power to impose death sentence on the accused in a criminal case?
- (1) First class magistrate court
 - (2) Second class magistrate court
 - (3) Third class magistrate court
 - (4) None of these
23. Which of the following statements regarding session's court is wrong?
- (1) Sessions court is the highest criminal court at the district level
 - (2) Sessions court can impose unconditional death sentence on the accused
 - (3) High court has a supervisory jurisdiction over Sessions court
 - (4) Both (1) and (3)
24. Which high court is common for more than three states?
- (1) Sikkim High court
 - (2) Bombay High court
 - (3) Gouhati High court
 - (4) Lucknow High court
25. What is the privilege given to Consolidated Fund of India?
- (1) It is at the sole disposal of President
 - (2) It can be used in times of natural calamities
 - (3) The expenditure can not be discussed on the floor of the House
 - (4) All the above

PRACTICE EXERCISE 7 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following persons can be eligible to contest for member of Lok Sabha but not for Presidential election?
 - (A) 'A' who was 38 years old and not educated
 - (B) 'B' who was 25 years old and is a graduate
 - (C) 'C' who was 37 years old and is a tax payer
 - (D) 'D' who was 27 years old and is not educated
 - (E) 'E' who was 24 years old and is not educated
 - (1) A, C
 - (2) B, D, E
 - (3) B, D
 - (4) All
2. In which year, the first President was appointed?
 - (1) 1945
 - (2) 1950
 - (3) 1952
 - (4) 1947
3. When was Mrs Prathibha Patil appointed as President?
 - (1) July 2012
 - (2) July 2007
 - (3) July 2008
 - (4) July 2006
4. Which of the following is the difference between bill and act of parliament?
 - (1) A bill becomes act after the assent of President
 - (2) A bill becomes act after discussion in Lok Sabha
 - (3) A bill becomes act after it is passed in both houses
 - (4) A bill becomes act after it is passed in Lok Sabha
5. What is the difference between ordinance and Act of Parliament?
 - (1) Ordinance can be amended while act cannot be amended
 - (2) Ordinance can be issued by President when the bill is rejected by one of the houses
 - (3) Ordinance can be issued by President when the bill is rejected by Upper House
 - (4) Ordinance can be issued by President when the parliament is not in session.
6. Which of the following statement is/are false regarding the limitations regarding passing of money bills?
 - (1) The bill should not be returned by President for reconsideration
 - (2) The bill should not be introduced in the House without prior approval of President
 - (3) The bill should not be sent to Rajya Sabha for discussion
 - (4) None of these
7. What is the requisite for introduction of the impeachment motion in the Lok Sabha?
 - (1) $\frac{1}{4}$ of the total members have to propose the allegation
 - (2) $\frac{2}{3}^{\text{rd}}$ of the total members have to propose the allegation

- (3) 1/3rd of the total members have to propose the allegation
 (4) There is no restriction regarding the number of members
8. Which among the following is not the function of 'President'?
- (1) Approving some bills for assent by State legislatures
 (2) Appointment of election commissioners
 (3) Allotment of portfolios to the ministers
 (4) Prior approval for money bills to be introduced in any house
9. Sachin Tendulkar is a member of Rajya Sabha. But, he is not eligible for voting for Presidential election. Identify the correct reason.
- (1) He has not fulfilled the age criteria.
 (2) He became member after the elections for President.
 (3) He is not the elected member of Rajya Sabha.
 (4) Members of Rajya Sabha are not entitled to vote.
10. The parliament is not vested with which of the following powers as far as judiciary is concerned?
- (1) Appointment of judges
 (2) Reducing the pay and allowances of judges
 (3) Removal of judges
 (4) Increasing the pay and allowances of judges
11. What is the term of office of Chief Justice of Supreme Court?
- (1) 5 years
 (2) 6 years
 (3) Attaining 62 years age
 (4) Attaining 65 years age
12. A person was born in 1983. He/She is not eligible to contest for which of the following elections in 2014?
- (1) Lok Sabha
 (2) Rajya Sabha
 (3) President
 (4) Both (2) and (3)
13. Who among the following persons is eligible to participate in the elections for Lok Sabha, Rajya Sabha and President in 2017?
- (1) The persons born before 1990
 (2) The persons born before 1985
 (3) The persons born before 1980
 (4) The persons born before 1993
14. What is the exclusive power of Rajya Sabha?
- (1) Constitution of All India Services
 (2) Removal of Vice President
 (3) Constitutional amendment
 (4) Approval for proclamation of State of emergency
15. The total number of members in the legislative council of Andhra Pradesh is 90. How many members can be nominated by the governor?
- (1) 30 (2) 45
 (3) 12 (4) 15
16. Identify the pair of states having unicameral legislature.
- (1) Uttar Pradesh and Karnataka
 (2) Andhra Pradesh and Kerala
 (3) Maharashtra and Chhattisgarh
 (4) Tamil Nadu and West Bengal
17. What is the maximum time allowed by the upper house to withhold a money bill?
- (1) 30 days (2) 14 days
 (3) 45 days (4) 15 days
18. How long can a governor keep the bill without giving assent?
- (1) 3 months (2) 1 month
 (3) 2 months (4) No fixed time period
19. The total strength of Legislative council of Karnataka is 75. Among these 25 members are
- (1) elected by graduates
 (2) elected by teachers
 (3) elected by local bodies
 (4) nominated by Governor
20. What is the age of superannuation of judges of High court?
- (1) 58 years (2) 60 years
 (3) 65 years (4) 62 years
21. Which of the following is the highest criminal court at the district level?
- (1) Sessions court
 (2) District court
 (3) First class magistrate court
 (4) Magistrate court
22. Years of birth of some persons are given below. Identify the persons who become eligible for contesting in Rajya Sabha election in 2013?

- (A) 1986 (B) 1983
(C) 1981 (D) 1984
(E) 1982
(1) A, B, D (2) B, C, E
(3) B, E (4) B, C, D, E
23. Which of the following powers is exhibited by President without the advice of Prime Minister?
- (1) Granting of pardons for accused in criminal cases
(2) Assent to bills passed by state legislatures
(3) Issue of ordinances
(4) Both (1) and (2)
24. Who exercises control over the Consolidated Fund of India?
- (1) Prime Minister (2) President
(3) Finance Minister (4) Lok Sabha
25. Which of the following comes under the original jurisdiction of both Supreme Court and High Court?
- (1) River water disputes
(2) Dispute regarding election of President
(3) Disputes regarding violation of fundamental rights
(4) Disputes regarding the subjects in concurrent list

ANSWER KEYS

PRACTICE EXERCISE 7 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 4 | 3. 2 | 4. 4 | 5. 3 | 6. 4 | 7. 3 | 8. 1 | 9. 1 | 10. 4 |
| 11. 1 | 12. 2 | 13. 1 | 14. 3 | 15. 1 | 16. 4 | 17. 3 | 18. 1 | 19. 1 | 20. 3 |
| 21. 2 | 22. 4 | 23. 2 | 24. 3 | 25. 3 | | | | | |

PRACTICE EXERCISE 7 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 2 | 3. 2 | 4. 1 | 5. 4 | 6. 3 | 7. 1 | 8. 3 | 9. 3 | 10. 2 |
| 11. 4 | 12. 4 | 13. 3 | 14. 1 | 15. 4 | 16. 4 | 17. 2 | 18. 4 | 19. 3 | 20. 4 |
| 21. 1 | 22. 2 | 23. 4 | 24. 2 | 25. 3 | | | | | |

ECONOMICS

PART 9

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PRACTICE EXERCISE 1 (A)

(1) Canada (2) Iran
(3) Iraq (4) Saudi Arabia

10. What is the main criterion used by the World Bank in classifying different countries?
 - (1) Literacy rate (2) Crude oil reserves
 - (3) per capita income (4) None of these
11. According to World Development Report 2006, the countries with _____ dollars p.a. and above are called developed countries?
 - (1) 10066 (2) 9486
 - (3) 8567 (4) 7465
12. Which of the following is not a component of Human Development index HDI?
 - (1) Per Capita Income (2) Life Rate
 - (3) Literacy Rate (4) Poverty Rate
13. How has per capita income in India increased from 1950–51 to 2000?
 - (1) From ₹6500 to ₹16,500
 - (2) From ₹255 only in 1950–51 to ₹16,500 in 2000
 - (3) From ₹755 to ₹14500
 - (4) From ₹1855 to ₹16,500
14. Which Indian State has better performance in terms of Human Development?
 - (1) Bihar (2) Orissa
 - (3) Kerala (4) Uttar Pradesh
15. National Income means
 - (1) Income of the State
 - (2) Income of the world
 - (3) Income of the Country
 - (4) None of these
16. GNP includes
 - (1) Value of consumer goods and services.
 - (2) Value of capital goods.
 - (3) Value of goods produced and services offered by the government.
 - (4) All of these
17. Urbanization means
 - (1) Civilization
 - (2) Increase in literacy
 - (3) Increase in employment
 - (4) Growth of urban Population
18. Human Development Index is based on
 - (1) Real income
 - (2) Life expectancy
 - (3) Adult literacy and years of schooling
 - (4) All of these
19. Mahatanob is committee reported on
 - (1) Distribution of national income and levels of living
 - (2) Water resources
 - (3) Social forestry
 - (4) Wildlife
20. Western Europe and North America are examples of
 - (1) mixed economy
 - (2) socialist economy
 - (3) capitalist economy
 - (4) None of these
21. India remained an underdeveloped country because of
 - (1) its dependence on agriculture.
 - (2) its inability to export surplus products.
 - (3) lack of industries.
 - (4) shortage of raw materials.
22. The index of modernization is
 - (1) the decrease in the number of cities.
 - (2) the increase in the number of towns.
 - (3) the growing population in rural areas.
 - (4) the stable population in rural areas.
23. The country that enjoys the socialist economic system.
 - (1) USA (2) UK
 - (3) China (4) India
24. The factors that cause inequalities of income are
 - (1) economical (2) social
 - (3) political (4) All of these
25. The Industrial Revolution occurred in England during the period of
 - (1) 1780–1820 (2) 1770–1830
 - (3) 1760–1780 (4) None of these
26. Free market conditions exist in _____ system
 - (1) Mixed economy (2) Socialist economy
 - (3) Capitalist economic (4) None of these
27. Small Farmers Development Agencies were intended to
 - (1) generate employment opportunities in rural areas.

- (2) to check rural indebtedness.
 (3) to control population in rural areas.
 (4) All of these
28. Inflation caused by increased
 (1) cost-push
 (2) structural inflation
 (3) stagnation
 (4) demand pull inflation
29. With regard to industrial growth, this state ranks first.
 (1) Andhra (2) Tamil Nadu
 (3) Gujarat (4) Maharashtra
30. In which state in India is the infant mortality rate lowest?
 (1) Kerala (2) Bihar
 (3) Uttar Pradesh (4) Punjab

PRACTICE EXERCISE 1 (B)

Directions for questions 1 to 30: Select the correct alternative from the given choices.

- Economic development refers to
 (1) economic growth.
 (2) changes in output distribution and economic structure.
 (3) improvement in the well-being of the urban population.
 (4) Both (1) and (2)
- Which of the following is the neighbouring country that has less 'per capita income'?
 (1) Myanmar (2) Sri Lanka
 (3) Pakistan (4) Nepal
- According to 2010 records, HDI rank of India is _____ among 187 countries.
 (1) 131 (2) 132
 (3) 133 (4) 134
- According to 2011 census, male literacy rate is _____ in percentage.
 (1) 82.14 (2) 83.65
 (3) 86.16 (4) 87.28
- According to 2011 census, which of the following states of India has lowest literacy rate?
 (1) Lakshadweep (2) Kerala
 (3) Bihar (4) Tripura
- PDS stands for
 (1) Power Development System.
 (2) Public Development System.
 (3) Public Distribution System.
 (4) None of these
- IMR stands for
 (1) Indian Monitory Reserve.
 (2) International Monitory Reserve.
 (3) Infant Mortality Rate.
 (4) None of these
- Which of the following countries has the highest crude oil reserves?
 (1) United Arab Emirates
 (2) Iran
 (3) Iraq
 (4) Saudi Arabia
- Assume that there are 100 families in a country, the average per capita income of these families is ₹10000 and the average per capita income of 50 of these families is ₹5000. The average per capita income of the remaining families is
 (1) ₹5000 (2) ₹10000
 (3) ₹15000 (4) ₹20000
- UNDP measures the development of country based on
 (1) Health (2) Education
 (3) Income (4) All of these
- According to World Development Report 2006, the countries with _____ dollars p.a. and below are called low income countries.
 (1) 906 (2) 825
 (3) 674 (4) 567
- What is the most common method of measuring the economic development of a country?
 (1) Freedom (2) Equal treatment
 (3) Security (4) Income

13. Overall welfare of people in any society is determined by
 (1) Average
 (2) General Levels of Literacy
 (2) Health Status
 (4) All of these
14. If four groups of people in a country have individual incomes of ₹4,000, ₹5000, ₹6000, and ₹7000, what would be the average national income?
 (1) ₹4500 (2) ₹5000
 (3) ₹5500 (4) ₹6000
15. NNP at factor cost means
 (1) National Income
 (2) National Expenditure
 (3) National Wealth
 (4) National Capital
16. Per Capita Income =
 (1) $\frac{\text{Income from capital}}{\text{Population}}$
 (2) $\frac{\text{Income from Taxes}}{\text{Population}}$
 (3) $\frac{\text{National Income}}{\text{Population}}$
 (4) $\frac{\text{Population}}{\text{National Income}}$
17. Decrease in Death rates
 (1) Economic Indicator
 (2) Political indicator
 (3) Social indicator
 (4) Demographic indicator
18. Income earned from labour and work is known as
 (1) earned income (2) unearned income
 (3) national income (4) None of these
19. India is a
 (1) Capitalist economy
 (2) Mixed economy
 (3) Socialist economy
 (4) None of these
20. The percentage of the total India's population depending on agricultural sector is
 (1) 55 (2) 60
 (3) 64 (4) 70
21. One of the largest rice producing states is
 (1) Kerala (2) Gujarat
 (3) Punjab (4) Andhra Pradesh
22. The 1991 census was not held in this state.
 (1) Punjab (2) Jammu and Kashmir
 (3) Karnataka (4) Andhra Pradesh
23. The privileged social classes created by the British through legislation was
 (1) Brahmins (2) Revenue officers
 (3) Zamindars (4) None of these
24. The system in which people hold single independent holdings is
 (1) Zamindari system
 (2) Mahalwari system
 (3) Ryotwari system
 (4) Community system
25. Large scale industrial units and agricultural units with a defined pattern of production and employment are called
 (1) unorganized sector (2) organized sector
 (3) agricultural sector (4) None of these
26. CAD stands for
 (1) Command Area Development.
 (2) Community Area Development.
 (3) Communal Area Development.
 (4) Common Authority Development.
27. According to a composite index of regional development which state stands first in India?
 (1) Maharashtra (2) Haryana
 (3) Kerala (4) Punjab
28. The policy of balanced regional development was adopted in the
 (1) Third Plan (2) Fourth Plan
 (3) Fifth Plan (4) Sixth Plan
29. The country with the highest adult literacy is
 (1) India (2) China
 (3) Pakistan (4) Korea
30. Which of the following is the measure of sustainable development?
 (1) Green National Income
 (2) Genuine Savings
 (3) Green GNP
 (4) All of these

ANSWER KEYS

PRACTICE EXERCISE 1 (A)

1. 1	2. 2	3. 2	4. 3	5. 3	6. 3	7. 3	8. 2	9. 1	10. 3
11. 1	12. 4	13. 2	14. 3	15. 3	16. 4	17. 4	18. 4	19. 1	20. 3
21. 1	22. 2	23. 3	24. 4	25. 1	26. 3	27. 1	28. 1	29. 4	30. 1

PRACTICE EXERCISE 1 (B)

1. 4	2. 1	3. 4	4. 1	5. 2	6. 3	7. 3	8. 4	9. 3	10. 4
11. 2	12. 4	13. 4	14. 3	15. 1	16. 3	17. 4	18. 2	19. 2	20. 4
21. 4	22. 2	23. 3	24. 2	25. 2	26. 1	27. 4	28. 1	29. 4	30. 4

Sectors of Indian Economy

PRACTICE EXERCISE 2 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. In terms of nominal GDP, which position does India occupy in the world?
(1) 11th largest (2) 10th largest
(3) 9th largest (4) 8th largest
2. In terms of nominal factory output, which position does India occupy in the world?
(1) 10th largest
(2) 11th largest
(3) 12th largest
(4) 13th largest
3. Which of the following is the reason for underemployment?
(1) No recognition from the government
(2) People are lazy in working
(3) Less number of jobs
(4) People are working less than what they are capable of
4. Arrange the following in the same order of primary, secondary and tertiary sectors.
(A) Fisherman
(B) Judge
(C) Milk vendor
(1) B, A, C (2) A, C, B
(3) C, B, A (4) C, A, B
5. Which of the following reasons are responsible for making the tertiary sector important in India?
(1) IT is becoming very important
(2) People are demanding more services
(3) Huge development in primary and secondary sectors
(4) All of these
6. In which of the following ways can a government improve employment in rural areas?
(1) By constructing new dams and canals
(2) By providing better roads and trade
(3) By providing loans at cheaper rates
(4) All of these
7. Find the odd one out of the following.
(1) MTNL (2) Air India
(3) Sahara Airlines (4) BPCL

8. The sectors are classified into private sector and public sector on the basis of
 - (1) number of workers.
 - (2) employment conditions.
 - (3) economic activity.
 - (4) ownership of enterprises.
9. Which of the following is not an activity related the unorganized sector?
 - (1) An engineer drawing a rough sketch of a dam
 - (2) A chef is preparing food in a restaurant
 - (3) A lecturer is teaching in a college
 - (4) A doctor is treating a patient in a hospital
10. In terms of GDP, the share of primary sector in 2003 is about _____ percentage.
 - (1) 20
 - (2) 35
 - (3) 50
 - (4) 55
11. In terms of employment, the share of tertiary sector in 2000 is about _____ percentage.
 - (1) 40
 - (2) 35
 - (3) 30
 - (4) 25
12. NSSO stands for
 - (1) National Sample Survey Organization
 - (2) National Sectors Standard Organization
 - (3) National Sample Sectors Organization
 - (4) None of these
13. Which sector is also called 'agriculture and related sector'?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) None of these
14. Which sector is also called 'industrial sector'?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) None of these
15. Which of the following sectors aid or support the production process?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) None of these
16. Which of the following sector(s) are the most important in India?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) All of these
17. Which of the following activities does not fall in the tertiary sector?
 - (1) Banking
 - (2) Communication
 - (3) Manufacturing
 - (4) Transport
18. Which of the following sectors is contributing the most towards the GDP in India?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) None of these
19. The number of sectors Indian economy is divided into are
 - (1) 1
 - (2) 2
 - (3) 3
 - (4) 6
20. Which sector has the advantage of paid leave?
 - (1) Unorganized sector
 - (2) Organized sector
 - (3) Rural sector
 - (4) None of these
21. Which of the following is a public sector?
 - (1) Post Office
 - (2) TISCO
 - (3) RIL
 - (4) All of these
22. Workers in which of the following sectors do not produce goods?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) None of these
23. Which of the following sector(s) are interdependent?
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) All of these
24. Which sectors have failed to generate enough employment opportunities in India?
 - (A) Primary
 - (B) Secondary
 - (C) Tertiary
 - (1) A and B
 - (2) B and C
 - (3) A and C
 - (4) A, B and C
25. NREGA stands for
 - (1) National Rural Employment Guarantee Act.
 - (2) National Rural Employment Grant Act.
 - (3) National Rural Education Grant Act.
 - (4) None of these

PRACTICE EXERCISE 2 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Which of the following Acts would not apply to a company like Tisco?
 - (1) Minimum Wages Act
 - (2) National Rural Employment Guarantee Act
 - (3) Factories Act
 - (4) Payment of Gratuity Act
2. Which position does India occupy in the world in terms of services output?
 - (1) 10th largest
 - (2) 11th largest
 - (3) 12th largest
 - (4) 13th largest
3. Arrange the following in the same order of primary, secondary and tertiary:
 - (A) Engineer
 - (B) Mat weaver
 - (C) Miner
 - (1) A, B, C
 - (2) B, C, A
 - (3) C, B, A
 - (4) C, A, B
4. Who measures the GDP in India?
 - (1) State government
 - (2) Central government
 - (3) World Bank with the help of the central government
 - (4) Central government with the help of state governments
5. What is the main reason for more employment in primary sector?
 - (1) Many opportunities in primary sector
 - (2) Enough jobs were not created in secondary and tertiary sectors
 - (3) People are interested in primary sector
 - (4) None of these
6. Find the odd one out of the following.
 - (1) Doctor
 - (2) Police
 - (3) Barber
 - (4) Milk vendor
7. How does the government protect people who are working in unorganized sectors in rural areas?
 - (A) By providing basic needs free of cost
 - (B) By providing agricultural inputs
 - (C) By providing trade facilities
 - (D) By providing marketing outlets
8. AIIMS was set up by the government of India
 - (1) to provide electricity at a lower cost than the actual cost of the production.
 - (2) to protect and encourage private sector especially small scale industries.
 - (3) to provide quality health services at reasonably cost.
 - (4) None of these
9. NREGA guarantees a minimum of _____ days of employment to atleast one member from every household.
 - (1) 100
 - (2) 120
 - (3) 180
 - (4) 200
10. In terms of GDP, the share of secondary sector in 2003 was about _____ percentage.
 - (1) 20
 - (2) 25
 - (3) 50
 - (4) 55
11. In terms of employment, the share of primary sector in 2000 is about _____ percentage.
 - (1) 65
 - (2) 60
 - (3) 50
 - (4) 45
12. When we produce goods by using natural resources, it is an activity of _____ sector.
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) All of these
13. Manufacturing goods from natural products is an activity of _____ sector.
 - (1) Primary
 - (2) Secondary
 - (3) Tertiary
 - (4) All of these
14. Spinning of yarn and weaving of cloth by using cotton fibre from the plant, is an activity of _____ sector.
 - (1) Agriculture and related
 - (2) Service
 - (3) Industrial
 - (4) None of these
15. Which of the following come under the tertiary sector?
 - (1) Banking
 - (2) Transport
 - (3) Trade
 - (4) All of these

16. Which of the following sector(s) provide maximum employment in India?
 (1) Primary (2) Secondary
 (3) Tertiary (4) All of these
17. Which was the scheme launched by the government of India for 'Right to work' in September 2005?
 (1) NREGA (2) AAY
 (3) PMRY (4) None of these
18. The growth of the secondary sector spread its influence during the Industrial Revolution in
 (1) 17th Century (2) 18th Century
 (3) 19th Century (4) 20th Century
19. Which of the following comes under the private sector?
 (1) Railways (2) TISCO
 (3) Post Office (4) All of these
20. In which of the following sector workers have job security?
 (1) Primary (2) Secondary
 (3) Tertiary (4) Both (2) and (3)
21. The motive of public sector enterprise is
 (1) profit making
 (2) entertainment
 (3) social welfare and security
 (4) None of these
22. When more people are engaged in a work than required what does it indicate?
 (1) Unemployment
 (2) Over employment
 (3) Disguised employment
 (4) Surplus employment
23. Public enterprises are owned by
 (1) individual owners
 (2) government
 (3) both government and individual
 (4) None of these
24. In which of the following sector do workers enjoy job security?
 (1) Primary (2) Organized
 (3) Unorganized (4) All of these
25. When we produce goods by exploiting natural resources, it is an activity of the _____ sector.
 (1) Primary
 (2) Secondary
 (3) Tertiary
 (4) None of these

ANSWER KEYS

PRACTICE EXERCISE 2 (A)

1. 1	2. 3	3. 4	4. 2	5. 4	6. 4	7. 3	8. 4	9. 2	10. 2
11. 4	12. 1	13. 1	14. 3	15. 3	16. 1	17. 3	18. 3	19. 3	20. 2
21. 1	22. 3	23. 4	24. 2	25. 1					

PRACTICE EXERCISE 2 (B)

1. 2	2. 4	3. 3	4. 4	5. 2	6. 4	7. 3	8. 3	9. 1	10. 1
11. 2	12. 1	13. 2	14. 3	15. 4	16. 1	17. 1	18. 1	19. 2	20. 4
21. 3	22. 3	23. 2	24. 2	25. 1.					

Money and Credit

PRACTICE EXERCISE 3 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Money is called a medium of exchange because
 - (1) it can be easily exchanged for any commodity or service.
 - (2) it eliminates the need for double coincidence.
 - (3) it acts as an intermediate in the exchange process.
 - (4) all of these
2. Which of the following is the main source of credit for the rich house hold?
 - (1) Informal Sector
 - (2) Formal Sector
 - (3) Both formal and informal
 - (4) Neither formal or informal
3. Which among the following is an essential feature of barter system?
 - (1) A person holding money can easily exchange any commodity
 - (2) It is based on double coincidence of wants
 - (3) It is generally accepted as medium of exchange of goods with money.
 - (4) It acts as a measure and store of value.
4. The one rupee note bears the signature of
 - (1) Secretary, Ministry of Finance
 - (2) Governor, RBI
 - (3) Finance Minister
 - (4) None of these
5. India's maximum foreign exchange is spent on
 - (1) import of foodgrains
 - (2) import of iron and steel
 - (3) import of petroleum products
 - (4) import of technical know-how
6. Which of the following factors contribute to inflation?
 - (1) 20 per cent increase in prices of agricultural commodities
 - (2) 20 per cent increase in money supply
 - (3) 20 per cent fall in the production of industrial products.
 - (4) None of these
7. Which of the following years, Reserve Bank of India (RBI) came into existence?
 - (1) 1935
 - (2) 1936
 - (3) 1937
 - (4) 1932

8. Indian currency was last devalued in
 (1) 1955 (2) 1956
 (3) 1991 (4) 1967
9. How many banks were nationalized in the year 1969?
 (1) 6 (2) 4
 (3) 5 (4) 20
10. Disguised unemployment is the prominent feature of
 (1) tertiary sector (2) secondary sector
 (3) primary sector (4) All of these
11. Government prepares a budget for each
 (1) financial year (2) calendar year
 (3) leap year (4) Five years
12. Cheque is a
 (1) money (2) legal tender money
 (3) optional money (4) None of these
13. Which one of the following is the custodian of Foreign Exchange Reserve?
 (1) Chief Minister (2) Prime Minister
 (3) Commercial Bank (4) Reserve Bank
14. The silver coin Pana, was a standard currency during the time of
 (1) Guptas (2) Mauryas
 (3) Harsha (4) Kanishka
15. The excess of government's revenue expenditure over revenue receipts constitutes
 (1) fiscal deficit (2) primary deficit
 (3) budget deficit (4) revenue deficit
16. The National Bank for Agriculture and rural Development (NABARD) was set up in
 (1) 1979 (2) 1980
 (3) 1981 (4) 1982
17. Since money acts as an intermediate in the exchange process, it is called
 (1) value for money (2) exchange value
 (3) medium of exchange (4) None of these
18. Deposits in bank accounts withdrawn on demand are called
 (1) fixed deposits (2) recurring deposits
 (3) demand deposits (4) None of these
19. Major portion of the deposits is used by banks for
 (1) setting up new branches.
 (2) paying taxes.
 (3) paying interest on loans.
 (4) extending loans.
20. A 'debt trap' means
 (1) inability to repay credit amount.
 (2) ability to pay credit amount.
 (3) Over spending till no money is left.
 (4) None of these
21. Formal sources of credit do not include
 (1) banks (2) cooperatives
 (3) employers (4) None of these
22. The export import (EXIM) Bank was set up in
 (1) 1980 (2) 1982
 (3) 1981 (4) 1989
23. What is the name of the success story that met the credit needs of the poor, at reasonable rates, in Bangladesh?
 (1) Grameen Bank (2) Reserve Bank
 (3) Cooperative Bank (4) None of these
24. First gold coins were introduced during the reign of
 (1) Harsha (2) Gupta
 (3) Shahjahan (4) None of these
25. When did the first nationalization of Banks take place?
 (1) 1969 (2) 1966
 (3) 1965 (4) 1967

PRACTICE EXERCISE 3 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Currency is issued by
 (1) RBI on behalf of Central Government.
 (2) By President of India.
2. Who among the following is the present Governor of RBI?
 (1) D. Subba Rao (2) Sachindra Reddy
 (3) Rangarajan (4) None of these
- (3) By Finance Minister.
 (4) None of these

3. Which of the following two aims for which people deposit their money in banks?
 - (1) Their money is safe in banks
 - (2) It exchanges their status
 - (3) They get interest in return
 - (4) Both 1 and 3.
4. Which one of the following is not an affiliate of the Reserve Bank of India?
 - (1) IDBI
 - (2) Agriculture Refinance Corp
 - (3) UTI
 - (4) Deposit Insurance Corp
5. Which of the following is a direct tax?
 - (1) Excusive
 - (2) Sales tax
 - (3) Income tax
 - (4) None of these
6. Who among the following was the first to estimate the country's per capita national income during the British rule for the year 1888?
 - (1) Pt Jawaharlal Nehru
 - (2) Prof P.C. Mahalanobis
 - (3) Dadabhai Naoroji
 - (4) None of these
7. The Indian financial year begins on
 - (1) 1 January
 - (2) 1 April
 - (3) 1 July
 - (4) None of these
8. The first Indian bank was
 - (1) Traders Bank
 - (2) Imperial Bank
 - (3) Presidency Bank Kolkata
 - (4) None of these
9. Who among the following was the first Indian Governor of the RBI?
 - (1) C.D. Deshmukh
 - (2) Sachindra Reddy
 - (3) S. Mukherjee
 - (4) None of these
10. An example of property tax
 - (1) Wealth tax
 - (2) Income tax
 - (3) Sales tax
 - (4) Excise duty
11. Money serves as a
 - (1) medium of exchange.
 - (2) measure of value.
 - (3) store of value.
 - (4) All of these
12. Draft is issued by
 - (1) Reserve Bank of India
 - (2) Commercial Bank
 - (3) World Bank
 - (4) Business firms
13. 'Besant' was a gold coin during ancient
 - (1) Roman Period
 - (2) Greek Period
 - (3) Egyptian Period
 - (4) British Period
14. Which of the following are the functions of the RBI?
 - (1) Issue of the Currency.
 - (2) Banker to the Government.
 - (3) Bankers Bank.
 - (4) All of these
15. Railway Budget is presented by
 - (1) Prime Minister
 - (2) Finance Minister
 - (3) Railway Minister
 - (4) Chief Minister
16. Write the full form of SEBI.
 - (1) Securities and Exchange Board of India
 - (2) South Eastern Board of India
 - (3) Secondary Education Board of India
 - (4) None of these
17. Modern forms of money include
 - (1) paper notes
 - (2) gold coins
 - (3) silver coins
 - (4) copper coins
18. Banks in India these days, hold about _____ per cent of their deposit as cash.
 - (1) 50
 - (2) 20
 - (3) 15
 - (4) 10
19. In rural areas farmers take credit for
 - (1) family
 - (2) health
 - (3) crop production
 - (4) education
20. Which of the following does the terms of credit do not include?
 - (1) interest rate
 - (2) collateral
 - (3) documentation
 - (4) lender's land
21. Banks and cooperatives need to lend more to borrowers because
 - (1) high cost of borrowing form informal sources.
 - (2) borrowers wish to set up enterprises.
 - (3) borrowers need more money but cannot ask.
 - (4) None of these

22. In a SHG, most of the decisions regarding savings and loan activities are taken by
- (1) bank
 - (2) group member
 - (3) non-government organization
 - (4) government
23. NREGA Stands for
- (1) New Revolution Employment Guarantee Act
 - (2) National Rural Exchange Guarantee Act
 - (3) National Rural Employment Guarantee Act
 - (4) National Rajiv Employment Guarantee Act
24. Currency notes in India are printed and supplied by
- (1) Security Press, Nasik
 - (2) Security Press, Mumbai
 - (3) Security Press, Noida
 - (4) RBI, New Delhi
25. First indigenous bank established in 1894 was
- (1) Central Bank of India
 - (2) Punjab National Bank
 - (3) Reserve Bank of India
 - (4) Imperial Bank of India

ANSWER KEYS

PRACTICE EXERCISE 3 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 4 | 2. 2 | 3. 2 | 4. 1 | 5. 3 | 6. 2 | 7. 1 | 8. 3 | 9. 2 | 10. 3 |
| 11. 1 | 12. 3 | 13. 4 | 14. 2 | 15. 4 | 16. 4 | 17. 3 | 18. 3 | 19. 4 | 20. 1 |
| 21. 3 | 22. 2 | 23. 1 | 24. 2 | 25. 1 | | | | | |

PRACTICE EXERCISE 3 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 1 | 3. 4 | 4. 1 | 5. 3 | 6. 3 | 7. 2 | 8. 3 | 9. 3 | 10. 1 |
| 11. 4 | 12. 3 | 13. 1 | 14. 4 | 15. 3 | 16. 1 | 17. 1 | 18. 3 | 19. 3 | 20. 4 |
| 21. 1 | 22. 2 | 23. 3 | 24. 1 | 25. 2 | | | | | |

Globalization and Indian Economy

PRACTICE EXERCISE 4 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Ford motors is an MNC because
 - (1) it was initially set up by an American named Henry Ford.
 - (2) it has manufacturing plants spread over 26 countries of the world.
 - (3) it has immense capital at its disposal.
 - (4) None of these
2. Foreign trade is desirable as it
 - (1) generates good will among countries of the world.
 - (2) promotes flow of culture from one country to another.
 - (3) it enables developing countries to grow economically.
 - (4) None of these
3. How many countries are member countries of WTO?
 - (1) 120
 - (2) 149
 - (3) 86
 - (4) 58
4. Globalization integrates different countries through
 - (1) foreign trade.
 - (2) foreign investment.
 - (3) multinational companies.
 - (4) All of these
5. In which of the following year was the privatization in India?
 - (1) 1957
 - (2) 1995
 - (3) 1991
 - (4) 1926
6. The most dominant group in the WTO is of
 - (1) developing countries.
 - (2) developed countries.
 - (3) asian countries.
 - (4) None of these.
7. Name the organization which lay emphasis on liberalization of foreign trade and investment in India.
 - (1) WHO
 - (2) WTO
 - (3) UNESCO
 - (4) UNICEF
8. What are SEZs?
 - (1) Special Economic Zones
 - (2) Special Exercise Zones

- (3) Special Export Zones
(4) All of these
9. Which of these is the Indian MNC's?
(1) Tata Motors (2) Infosys
(3) Ranbaxy (4) All of these
10. Economic planning was introduced in India being inspired by the planning strategy of
(1) USA (2) USSR
(3) UK (4) None of these
11. The WTO was established on
(1) 1 January 1995
(2) 1 January 1991
(3) 1 January 1990
(4) 1 January 1992
12. Under the policy of liberalization, industrial licensing has been abolished except
(1) textiles
(2) transport equipment
(3) defence equipment
(4) electrical
13. The head office of WTO is located in
(1) New York (2) San Francisco
(3) Geneva (4) Copenhagen
14. Which of the following countries do not belong to OECD?
(1) Italy (2) Canada
(3) Japan (4) France
15. Which country share has declined in foreign trade since independence?
(1) Canada (2) Germany
(3) Japan (4) UK
16. We import a few items which are must for our economic development, they are
(1) Copper
(2) Zinc
(3) Fertilizers
(4) All of these
17. After Independence, India's foreign trade was confined to
(1) Britain
(2) Common Wealth Countries
(3) OPEC
(4) None of these
18. In 1950–51 India's total exports were
(1) 501 crore (2) 506 crore
(3) 601 crore (4) 606 crore
19. The chairman of the Planning Commission is
(1) the President
(2) the Finance Minister
(3) the Prime Minister
(4) the Minister for planning
20. The expenditure and revenue policy of the government is
(1) monetary policy
(2) fiscal policy
(3) liberalization policy
(4) globalization policy
21. In order to protect local consumers, the government imposes restrictions on
(1) imports
(2) exports
(3) Both of these
(4) None of these
22. The basic purpose of New Economic Policy is to encourage
(1) Liberalization
(2) Globalization
(3) Privatization
(4) Nationalization of Indian Economy
23. The aim of liberalization is to free the large private sector from
(1) Bureaucratic Control
(2) Political Control
(3) Social Control
(4) Foreign Control
24. The two agencies that solve the economic problems of various countries are
(1) WHO and IMF
(2) IBRD and IMF
(3) Country's own government and IMF
(4) None of these
25. Agriculture accounts for about the total value of country's exports.
(1) 18%
(2) 20%
(3) 15%
(4) 25%

PRACTICE EXERCISE 4 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Chinese toys have become more popular in India because
 - (1) they are imported items.
 - (2) they are easily available in Indian markets.
 - (3) they are innovative and also cheap.
 - (4) None of these
2. Globalization leads to
 - (1) no change in competition among the producers.
 - (2) lesser competition among the producers.
 - (3) greater competition among the producers.
 - (4) None of these
3. Which among the following sectors has benefited least because of globalization in India?
 - (1) Agricultural (2) Industrial
 - (3) Service (4) None of these
4. In which of the following year was the new economic reform or policy introduced in India?
 - (1) 1991 (2) 1989
 - (3) 2005 (4) 2008
5. LPG means
 - (1) Liberalization, Privatization, Globalization.
 - (2) Liberalization, Privatization, Generalization.
 - (3) Liberty, Poverty, Government.
 - (4) Liberty, Privatization, Governance.
6. Why do MNC's make investments?
 - (1) To increase their assets
 - (2) For their own benefits
 - (3) For the welfare of poor countries
 - (4) All of these
7. Why are the MNC's setting up their customer care centres in India?
 - (1) It provides cheap educated English speaking youth.
 - (2) It provides cheap uneducated workers.
 - (3) It has sound infrastructure.
 - (4) None of these
8. Where did the Ford Motors set up their large plant?
 - (1) At Mumbai (2) At Kolkata
 - (3) At Kanpur (4) At Chennai
9. Which one of the following is a basic function of foreign trade?
 - (1) It furnishes trade in the domestic market.
 - (2) Goods and services are produced for internal market.
 - (3) It gives opportunity for the reduction to reach beyond the domestic market.
 - (4) All of these
10. When did Ford motors come to India?
 - (1) 1990 (2) 1995
 - (3) 1996 (4) 1998
11. The Indian economic scenario was very much _____ in 1991.
 - (1) developing (2) depressing
 - (3) attractive (4) None of these
12. Restrictions on foreign investment and foreign technology have been withdrawn under
 - (1) liberalization (2) privatization
 - (3) globalization (4) None of these
13. Which of the following is the major item of imports in India?
 - (1) Iron and steel products
 - (2) Chemical products
 - (3) Petroleum
 - (4) None of these
14. Which of the following are the oil producing and exporting countries?
 - (1) Iran
 - (2) Iraq
 - (3) Kuwait and Saudi Arabia
 - (4) All of these
15. Which of the following is a major export item of India?
 - (1) Handicrafts (2) Spices
 - (3) Tea (4) None of these
16. Internal trade implies trade among
 - (1) different persons of three sectors of a country.
 - (2) different regions within a country.
 - (3) different trades within a country.
 - (4) All of these

17. Which of the following was the main aim of foreign trade before independence?
- To serve British interests
 - To serve India's interests
 - To serve all the British colonies in Asia
 - None of these
18. Which body maintains reserve of all currencies contributed by member countries according to fixed individual quota?
- IMF
 - IBRD
 - Reserve Bank
 - None of these
19. Which of the following controls regulates the economy?
- Liberalization
 - Monetary policy
 - Fiscal policy
 - None of these
20. Globalization means
- Integrating economy with world economy.
 - disintegrating economy with world economy.
 - economically dependent at the global level.
 - None of these
21. Sustainable development is a
- static concept.
 - dynamic long term concept.
 - static short term concept.
 - dynamic concept.
22. New Economic Policy facilitates investment by the _____ sector.
- public
 - private
 - joint
 - corporate
23. The WTO extends "the most, favoured nation", treatment to all its members on
- equality basis.
 - priority basis.
 - productivity basis.
 - None of these
24. Which of the following comes under direct tax?
- Custom duty
 - Income tax
 - Import duty
 - None of these
25. The minimum cash reserve ratio is fixed by
- RBI
 - SBI
 - IMF
 - None of these

ANSWER KEYS

PRACTICE EXERCISE 4 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 2 | 2. 3 | 3. 2 | 4. 4 | 5. 3 | 6. 2 | 7. 1 | 8. 1 | 9. 4 | 10. 2 |
| 11. 1 | 12. 3 | 13. 3 | 14. 1 | 15. 4 | 16. 4 | 17. 3 | 18. 4 | 19. 3 | 20. 2 |
| 21. 1 | 22. 2 | 23. 1 | 24. 3 | 25. 1 | | | | | |

PRACTICE EXERCISE 4 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 3 | 3. 1 | 4. 1 | 5. 1 | 6. 1 | 7. 1 | 8. 4 | 9. 4 | 10. 2 |
| 11. 2 | 12. 1 | 13. 3 | 14. 4 | 15. 1 | 16. 4 | 17. 1 | 18. 1 | 19. 2 | 20. 1 |
| 21. 2 | 22. 4 | 23. 1 | 24. 2 | 25. 1 | | | | | |

Consumer Rights

PRACTICE EXERCISE 5 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The consumer movement first of all begun in which of the following country?
(1) England (2) USA
(3) India (4) Pakistan
2. At the international level, this has become the foundation for consumer movement.
(1) Consumer International
(2) Copra
(3) Consumers forum
(4) None of these
3. Which one of these is a consumer right?
(1) Right to safety
(2) Right to information
(3) Right to choose
(4) All of these
4. When was ISO established?
(1) 1954 (2) 1986
(3) 1947 (4) 1960
5. Which of the following day is celebrated as the world consumer day?
(1) March 10
(2) March 12
(3) March 15
(4) March 14
6. How many District consumer courts/councils are there in India?
(1) 800 (2) 500
(3) 400 (4) 425
7. A chemist has sold you a medicine of expiry date. Under which consumer right you can approach the consumer court?
(1) Right to safety
(2) Right to seek redressal
(3) Right to education
(4) Right to equality
8. Which of the following is not a consumer right?
(1) Right to equality
(2) Right to choose
(3) Right to safety
(4) Right to seek redressal

9. Which one of the following rights is ensured to the citizens under the RTI act?
 - (1) Right to choose
 - (2) Right to safety
 - (3) Right to information
 - (4) Right to be heard
10. Which of the following is a fit case for intervention by consumer's court?
 - (1) The dealer stocks only expensive brands
 - (2) The dealer does not stock a particular brand
 - (3) The dealer charges more than the printed MRP
 - (4) The dealer charges less than the printed MRP
11. Every consumer is entitled to which information about the product?
 - (1) Composition of the ingredients.
 - (2) Formula for preparation.
 - (3) How the cost has been determined.
 - (4) Who owns the company making the product.
12. The first consumer movement started in England after the
 - (1) First World War (2) Second World War
 - (3) Cold War (4) None of these
13. Adulteration means
 - (1) mixing desirable materials in food.
 - (2) mixing undesirable materials in food.
 - (3) mixing undesirable materials in cloth material.
 - (4) None of these
14. Public distribution system is operated under the joint responsibility of
 - (1) Central and state governments.
 - (2) Public and private sectors.
 - (3) Cooperative and joint sectors.
 - (4) None of these
15. International Organization for Standardization (IOS) is located in
 - (1) Rome (2) New York
 - (3) Geneva (4) Hague
16. What is the full form of BPL in consumer awareness terms?
 - (1) Bharat Petroleum Limited.
 - (2) Below Poverty Line.
 - (3) Below Prosperity Line.
 - (4) None of these
17. Consumer awareness means educating consumers about
 - (1) the amount of products consumed.
 - (2) the quality of goods.
 - (3) the rights and duties.
 - (4) None of these
18. Sarva Priya Scheme means
 - (1) a scheme introduced for the welfare of the producers.
 - (2) a scheme where essential items are distributed at lower rates.
 - (3) a scheme where food grains are distributed at lower rates.
 - (4) None of these
19. The consumer welfare fund was created in
 - (1) 1992 (2) 1994
 - (3) 1996 (4) 1998
20. "Apne Adhikar" is the programme broadcasted by commercial stations of
 - (1) Door Darshan
 - (2) All India Radio
 - (3) The Ministry of broadcasting
 - (4) None of these
21. Which of the following does not fall under consumer rights?
 - (1) Right to be informed
 - (2) Right to choose
 - (3) Right to seek government help
 - (4) Right to represent the consumer court
22. For environmentalists, the goal of the marketing system is to maximize
 - (1) life quality.
 - (2) consumer satisfaction.
 - (3) consumer choice.
 - (4) consumption.
23. Which one of the following rights is ensured under the RTI Act?
 - (1) Right to choose
 - (2) Right to be informed
 - (3) Right to safety
 - (4) Right to be heard
24. You have joined an education institution and had paid the fee for the whole year but you found that the

institution is not providing what it promised. Now you want to change the institution but the management refused to refund your fee? Which of your right is being violated?

- (1) Right to safety
- (2) Right to choose
- (3) Right to be informed
- (4) Right to information

25. Which of the following pairs is not correct?

- (1) Accident due to faulty safety valve in the pressure cooker - Right to safety
- (2) Washing instructions on the label of garments - Right to information
- (3) Authenticity of gold and diamond jewellery - ISI mark
- (4) Complaints in consumer forums - Right to seek redressal

PRACTICE EXERCISE 5 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. When was the Consumer Protection Act first passed in India?

- (1) In 1966
- (2) In 1976
- (3) In 1986
- (4) In 1996

2. The consumer court that deals with claims exceeding ₹1 crore is at the

- (1) International level
- (2) National level
- (3) State level
- (4) District level

3. The cases involving claims up to ₹20 lakhs are dealt in

- (1) National Level Consumer Courts
- (2) State level Consumer Courts
- (3) District level Consumer Courts
- (4) The Office of Tehsildar

4. Who among the following is the father of consumer movement?

- (1) Ralph Nadar
- (2) Cliffword Beers
- (3) D. Touchton
- (4) None of these

5. What is the full form of ISO?

- (1) International Safety Organization.
- (2) International Space Organization.
- (3) International Organization for Standardization.
- (4) None of these.

6. MRP stands for _____

- (1) Middle Rest Period
- (2) Material Retail Price
- (3) Maximum Retail Price
- (4) Minimum Retail Price

7. COPRA stands for

- (1) Consumer Preservation Act.
- (2) Consumer Protection Act.
- (3) Consumer Protection Activities.
- (4) None of these

8. DMI stands for

- (1) District Medical Institute.
- (2) Directorate of Marketing and Intelligence.
- (3) Directorate of Medical Institute.
- (4) None of these

9. The consumer movement across the world arose due to

- (1) unfair trade practices that prevailed in the market.
- (2) dissatisfaction of the consumers.
- (3) lack of legal system to protect consumers from exploitation.
- (4) All of these

10. Which of the following item is covered by ISI?

- (1) LPG cylinders
- (2) Edible oils
- (3) Fruit jams
- (4) Gold ornaments

11. What are the two ways in which consumers are exploited?

- (1) Giving wrong details about the product
- (2) Short weighing and adulteration
- (3) Charging less than the MRP
- (4) None of these

12. *Upbhokta Jagran* is a

- (1) quarterly magazine
- (2) fortnightly magazine
- (3) half-yearly magazine
- (4) annual magazine

13. Sellers hold with the stock of essential commodities to create artificial scarcity which means
 (1) Black marketing (2) Hoarding
 (3) Adulteration (4) None of these
14. The Agmark is meant for
 (1) industrial products
 (2) dairy products
 (3) agricultural products
 (4) consumer goods
15. Factors leading to consumer exploitation are
 (1) adulteration (2) duplicate articles
 (3) substandard goods (4) All of these
16. National consumer day is celebrated on
 (1) 21 December (2) 22 December
 (3) 23 December (4) 24 December
17. Besides the National Commission there are _____ state commissions and _____ district forums.
 (1) 38, 562 (2) 35, 565
 (3) 35, 569 (4) 38, 563
18. Codex Alimentaries Commission develops international food products and was created by
 (1) Food and Agricultural Organization.
 (2) World Health Organization.
 (3) International Standards Organization.
 (4) Both (1) and (2)
19. Legislative measures that protect consumers interest are
 (1) The MRTP Act 1969.
 (2) The Standard of weights and measures Act 1976.
 (3) The Prevention of Food Adulteration Act 1976.
 (4) All of these
20. There are nearly _____ lakh fair price shops in India.
 (1) 4.5 (2) 5.5
 (3) 4.0 (4) 5.0
21. Which of the following arose out of dissatisfaction of the consumers as many unfair practices were being indulged in by the sellers?
 (1) Consumer Awareness
 (2) Consumer Movement
 (3) Consumer Rights
 (4) Consumer Duties
22. The cases dealt in state level courts have the claims between
 (1) ₹20 lakhs and ₹3 crores
 (2) ₹20 lakhs and ₹2.5 crores
 (3) ₹20 lakhs and ₹2 crores
 (4) ₹20 lakhs and ₹1 crore
23. Availing details of ingredients of a product.
 (1) Right to information (2) Right to safety
 (3) Right to be heard (4) None of these
24. Frequent food shortages, hoarding black marketing gave birth to the consumer movement in an organized form in the
 (1) 1940s (2) 1970s
 (3) 1960s (4) 1980s
25. Consumer movement in India has led to the formation of various organizations locally known as
 (1) Consumer Protection Councils
 (2) COPRA
 (3) Resident Welfare Associations (RWA)
 (4) None of these

ANSWER KEYS

PRACTICE EXERCISE 5 (A)

1. 1	2. 1	3. 4	4. 3	5. 3	6. 2	7. 2	8. 1	9. 3	10. 3
11. 1	12. 2	13. 2	14. 1	15. 3	16. 2	17. 3	18. 2	19. 1	20. 2
21. 3	22. 1	23. 2	24. 2	25. 3					

PRACTICE EXERCISE 5 (B)

1. 3	2. 2	3. 3	4. 1	5. 3	6. 3	7. 2	8. 2	9. 4	10. 1
11. 2	12. 1	13. 2	14. 3	15. 4	16. 4	17. 3	18. 4	19. 4	20. 1
21. 2	22. 4	23. 1	24. 3	25. 1					

Planning Achievements and Failures

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. National income means
 - (1) Income of the state.
 - (2) Income of the world.
 - (3) Income of the country.
 - (4) None of these
2. Green Revolution was introduced in our country in
 - (1) 1960s
 - (2) 1980s
 - (3) 1970s
 - (4) 1990s
3. Which one of the following is the largest wheat producing state in India?
 - (1) Andhra Pradesh
 - (2) Madhya Pradesh
 - (3) Maharashtra
 - (4) Punjab
4. Who among the following was the Chairman of the planning commission in 1950, when the planning commission commenced?
 - (1) Jawaharlal Nehru
 - (2) Sardar Vallabhai Patel
 - (3) Subhash Chandra Bose
 - (4) None of these
5. From which year did the 11th five year plan start?
 - (1) 2006
 - (2) 2007
 - (3) 2008
 - (4) 2010
6. The Central Banking functions in India are performed by the
 - (1) Central Bank of India
 - (2) Reserve Bank of India
 - (3) State Bank of India
 - (4) Punjab National Bank
7. In which of the five year plan, preference was given to agriculture?
 - (1) First
 - (2) Third
 - (3) Fourth
 - (4) Fifth
8. Which five year plan saw establishment of the steel plants at Durgapur, Bhilai and Rourkela?
 - (1) First Five year plan
 - (2) Second Five year plan
 - (3) Third Five year plan
 - (4) Fourth Five year plan

9. In a mixed economy like India, all the vital decisions are taken
 - (1) with social goals
 - (2) no private gains
 - (3) economic justice
 - (4) All of these
10. The indicators of economic growth in India are
 - (1) per capita income.
 - (2) rate of capital formation.
 - (3) the production of food grains.
 - (4) All of these
11. The integrated rural development programme was launched during _____ five year plan.
 - (1) fifth
 - (2) fourth
 - (3) third
 - (4) sixth
12. The rise in per capita income in the seventh five year plan was
 - (1) 3.2%
 - (2) 3.3%
 - (3) 3.4%
 - (4) 3.6%
13. Which of the following comes under indirect tax?
 - (1) Wealth tax
 - (2) Gift tax
 - (3) Sales tax
 - (4) House tax
14. Which of the following is necessary to opt for economic planning in India?
 - (1) To break the vicious circle of poverty
 - (2) To build the social and economic infrastructure
 - (3) To increase capital formation
 - (4) All of these
15. The minimum cash reserve ratio is fixed by
 - (1) Reserve Bank of India
 - (2) State Bank of India
 - (3) IMF
 - (4) None of these
16. 'Planned Economy for India' (1934) was the work of
 - (1) John Mathai
 - (2) M.N. Roy
 - (3) M. Visveswaraya
 - (4) Shriman Narayan
17. In order to promote village industrialization, Government of India has set up the Mahatma Gandhi Institute for Rural Industrialization in
 - (1) Hyderabad
 - (2) Wardha
 - (3) Kolkata
 - (4) Porbandar
18. The impact of Green Revolution was felt most in the case of
 - (1) wheat
 - (2) rice
 - (3) pulses
 - (4) oil seeds
19. Crop Insurance is the monopoly of
 - (1) National Insurance Company
 - (2) General Insurance Company
 - (3) Life Insurance Corporation
 - (4) NABARD
20. The period of the fifth five year plan was reduced by
 - (1) 1 year
 - (2) 2 years
 - (3) 3 years
 - (4) 1.5 years
21. In the first five year plan (1951–56) the national income rose to
 - (1) 20%
 - (2) 18%
 - (3) 24%
 - (4) 16%
22. First indigenous bank established in 1894 was
 - (1) Central Bank of India
 - (2) Punjab National Bank
 - (3) Reserve Bank of India
 - (4) Imperial Bank of India
23. Which one among the following is a developmental goal common to all?
 - (1) Freedom
 - (2) Equal opportunities
 - (3) Security and respect
 - (4) High levels of income and better quality of life
24. Who among the following defined that economy is a system by which people get a living?
 - (1) J.R Hicks
 - (2) A.J. Brown
 - (3) W.N. Loucks
 - (4) None of these
25. Agriculture contributes nearly _____ of GDP.
 - (1) 20%
 - (2) 22%
 - (3) 24%
 - (4) 26%

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Government prepares a budget for each
 - (1) financial year (2) calendar year
 - (3) leap year (4) five years
2. Foreign Exchange Maintenance Act (FEMA) was introduced in the year _____ in place of FERA.
 - (1) 1997 (2) 1999
 - (3) 1998 (4) 1991
3. The first five years plan started in
 - (1) 1940–46 (2) 1951–1955
 - (3) 1945–1950 (4) None of these
4. Which of the following plan was put off by three years due to the severe drought and aggression from China and Pakistan?
 - (1) Third five year plan
 - (2) Fourth five year plan
 - (3) Fifth five year plan
 - (4) Sixth five year plan
5. The present chairman of State Bank of India is
 - (1) Pratip Choudhuri
 - (2) Chanda Kochhar
 - (3) U.K. Singh
 - (4) D. Subbarao
6. Development expenditure of the central government does not include
 - (1) defence expenditure.
 - (2) expenditure on economic services.
 - (3) expenditure on social and communist services.
 - (4) grant to states.
7. Which of the following was focus area for the second five year plan?
 - (1) Agriculture (2) Industrialization
 - (3) Removing poverty (4) Self reliant
8. The agency that estimates the national income of India is
 - (1) RBI
 - (2) Planning Commission
 - (3) Ministry of Finance
 - (4) Central Statistical Organization
9. Controlling and regulating the economy is
 - (1) liberalization policy
 - (2) monetary policy
 - (3) fiscal policy
 - (4) None of these
10. The expenditure and revenue policy of the government is
 - (1) monetary policy (2) fiscal policy
 - (3) liberalization policy (4) globalization
11. Economic planning was introduced in India being inspired by the planning strategy of
 - (1) USSR (2) UK
 - (3) USA (4) None of these
12. The central focus of 8th five year plan was
 - (1) to generate more employment opportunities.
 - (2) to increase more communication facilities.
 - (3) to increase the value of foreign trade.
 - (4) None of these
13. What are the major long term objectives of Indian planning?
 - (1) Increasing national and per capita income
 - (2) Reducing inequalities
 - (3) Creating employment facilities
 - (4) All of these
14. The rate at which the RBI gives loans to the commercial banks is
 - (1) Interest rate (2) Bank rate
 - (3) Credit rate (4) None of these
15. Chronic unemployment is measured using
 - (1) US data (2) CWS data
 - (3) None of the two (4) Both 1 and 2
16. The planning commission was set up in accordance with the directive principles in
 - (1) Article 38 (2) Article 39
 - (3) Article 42 (4) Article 51A
17. Outcome Budget of a Government of India, introduced from 2005 is a joint effort between Finance Ministry and
 - (1) Finance Commission
 - (2) Expenditure Commission

- (3) Commerce Ministry
(4) Planning Commission
18. Which country had the largest share of FDI in India during the last decade
(1) Mauritius (2) USA
(3) Japan (4) UK
19. Which one of the following taxes is not shared by the central government with the states?
(1) Union excise duties (2) Customs duty
(3) Income tax (4) Estate duty
20. A subsidy means
(1) financial investment by the government.
(2) financial assistance provided by the government.
(3) compulsory rebate by the government.
(4) None of these
21. Who among the following was the first Indian Governor of the RBI?
(1) C.D. Deshmukh (2) Sachindra Ray
(3) S. Mukherjee (4) None of these
22. The two gaps theory refers to
(1) savings gap and wage goods gap.
(2) saving gap and exchange gap.
(3) saving gap and employment gap.
(4) the wage goods gap and exchange gap.
23. When did the new economic reform policy appear in India?
(1) 1991 (2) 2005
(3) 2008 (4) 1989
24. Our tenth five year plan period is
(1) 2002–2007
(2) 2001–2006
(3) 2000–2005
(4) None of these
25. The Chairman of the planning commission between 1998–2003 was
(1) Shri. I.K. Gujral
(2) Shri. A.B. Vajpayee
(3) Shri. V.P. Singh
(4) None of these

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 3 | 2. 1 | 3. 4 | 4. 1 | 5. 2 | 6. 2 | 7. 1 | 8. 2 | 9. 4 | 10. 4 |
| 11. _ | 12. 4 | 13. 3 | 14. 4 | 15. 1 | 16. 3 | 17. 2 | 18. 1 | 19. 2 | 20. 1 |
| 21. 2 | 22. 2 | 23. 4 | 24. 2 | 25. 4 | | | | | |

PRACTICE EXERCISE 6 (B)

- | | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. 1 | 2. 2 | 3. 2 | 4. 2 | 5. 1 | 6. 1 | 7. 2 | 8. 4 | 9. 2 | 10. 2 |
| 11. 1 | 12. 1 | 13. 4 | 14. 2 | 15. 4 | 16. 2 | 17. 4 | 18. 2 | 19. 2 | 20. 1 |
| 21. 1 | 22. 2 | 23. 1 | 24. 1 | 25. 2 | | | | | |

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MOCK TEST

PART 10

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Mock Test

Directions for questions 1 to 22: Select the correct alternative from the given choices.

1. How many digits in the following sequence, are immediately followed by a vowel and immediately preceded by a symbol?

d 6 e # 9 a b c 7 φ Δ 3 @ 4 t z \$ 2 i ☒ y # % 8 u m p 5

- (1) Two (2) Three
(3) Four (4) More than four
2. Bill is taller than Jill and Nill. Tim is not as tall as Jill. Bill is shorter than Din. Who is the shortest among them?
- (1) Jill
(2) Nill
(3) Tim
(4) Cannot be determined
3. Three out of the following four are similar in a particular way and hence form a group. Find the one that does not fit into the group.
- (1) Tokyo (2) Beijing
(3) Mumbai (4) Islamabad
4. Bat is related to Cricket in the same way as Racquet is related to _____.
(1) Football (2) Hockey
(3) Golf (4) Tennis
5. Three out of the following four are similar in a particular pattern and hence form a group. One among

the following does not fit into the group. Find the one which does not belong to that group.

- (1) DGE (2) PSU
(3) MPN (4) BEC

6. Find the missing term in the following series.

PMJ, SQO, VUT, _____, BCE

- (1) YXY (2) XXX
(3) XXY (4) YYY

7. If A is the daughter of the mother of the mother of B's daughter. How is A related to B if neither of them has any sister?

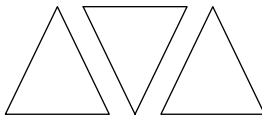
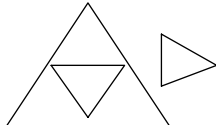
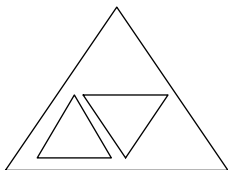
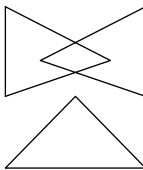
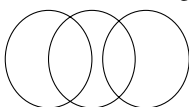
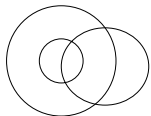
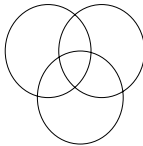
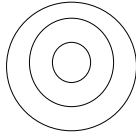
- (1) Brother
(2) Sister
(3) A is B
(4) Cannot be determined

8. Pointing at a photograph Ms Sudha told Mr Bhujbal, "the person in the photograph is your father's wife's mother-in-law's only son and my mother's brother's only brother-in-law". How is Bhujbal related to Sudha?

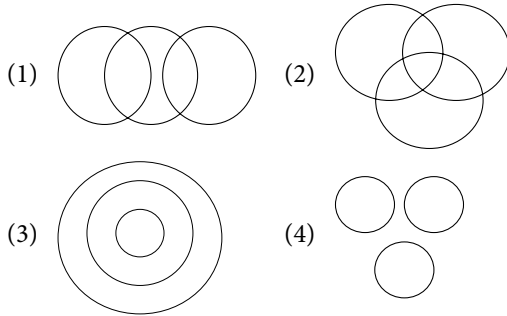
- (1) Brother (2) Cousin
(3) Uncle (4) Brother-in-law

9. Anjali is Prem's wife. Amrita is Prem's sister. Mahi is the son of Sudesh. Amrita is Sudesh's wife. How is Mahi related to Prem?

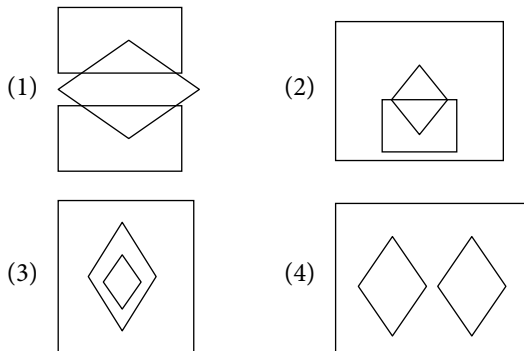
- (1) Cousin (2) Brother-in-law
(3) Uncle (4) Nephew

10. How is Rahul's sister's husband's father-in-law's only daughter-in-law's son related to Rahul?
- Son
 - Brother
 - Nephew
 - Cannot be determined
11. Mumbai is cooler than Chennai. Chennai is hotter than Hyderabad. Delhi is hotter than Mumbai and cooler than Hyderabad. Which among them is the coolest?
- Mumbai
 - Hyderabad
 - Chennai
 - Delhi
12. How many letters in the word 'SACRILEGE' remain in the same position when they are arranged in the alphabetical order?
- 3
 - 2
 - 1
 - 0
13. A and B are two faulty clocks. A loses 10 minutes for every hour and B gains 10 mins for every hour. What is the time shown by A when time shown by B is 7:00 pm. On the same day if both the clocks were set correctly at 12 noon on that day?
- 5:30 p.m.
 - 5:00 p.m.
 - 6:00 p.m.
 - 6:30 p.m.
14. Suresh started from his house and travelled 5 km towards the East. Then he turned to his left and travelled 10 km. Again turned to his right and travelled 5 km. Finally, he travelled 11 km to his right to reach the office. Approximately how far is his office located from his house and in which direction?
- 10 km, East
 - 10 km, South-East
 - 10 km, West
 - 10 km, North
15. In a certain code language, if LANGUAGE is coded as HOBMFHBV and STUDENTS is coded as EVUT-TUOF, then how is DISTRICT coded?
- UJTEUDIS
 - UTEJUDJS
 - UTJEUDJS
 - UTJFDUJS
16. In a certain code language, if ANSWER is coded as BPVAJX and CHOICE is coded as DJRMHK, then how is MINUTE coded in that language?
- NKQAYK
 - NKQZKY
 - NKQYZK
 - NKQYYK
17. If in a particular language, PAPER is coded as QQZQDS and PENCIL is coded as QDOBJK then how is SCIENCE coded in that language?
- TBIDOBF
 - TBJDOBF
 - JBTDOBF
 - TBJBOBD
18. If in a particular language, ARRANGEMENT is coded as AAEEGMNRRRT and DETAILED is coded as AEEIDDLT then how is NUMBER coded in that language?
- EUBNMR
 - EUBRMN
 - EUBNRM
 - EUBMNR
19. Which of the following combinations of figures best represents the relationship between crocodiles, lizards and reptiles?
- 
 - 
 - 
 - 
20. Which of the following diagrams best depicts peacocks, birds and living things?
- 
 - 
 - 
 - 

21. Which of the following combinations of circles best represents trains, cars and buses?



22. Which of the following combinations of figures best represents aunts, females and mothers?



Directions for questions 23 to 26: Three out of the following four are similar in a particular way and hence form a group. Find the one that does not belong to that group.

23. (1) $12 - 9$ (2) $25 - 49$
 (3) $34 - 64$ (4) $24 - 36$
24. (1) 28 (2) 126
 (3) 344 (4) 218
25. (1) 1040 (2) 2038
 (3) 1432 (4) 1648
26. (1) 101 (2) 103
 (3) 105 (4) 107

Directions for questions 27 to 30: These questions are based on the letter, digit and symbols sequence given below.

y 9 λ a b c e f 6 \$ 3 t φ m # g q n 8 Δ 2 p 4 \$ 5 % h 7

27. If all the symbols are ignored, then which element is the fifth element to the right of the sixth element to the left of the seventh element from the right end?

- (1) q (2) n
 (3) p (4) 6

28. In the given sequence, how many such letters are there which are immediately preceded and immediately followed by a letter?

- (1) One (2) Two
 (3) Three (4) Four

29. If the first half of the sequence is reversed, then which element is the fourth element to the left of the tenth element from the right end?

- (1) # (2) 8
 (3) y (4) 9

30. Find the missing term.

a f t, c \$ #, f t n, _____, t g \$.

- (1) \$ m 3 (2) \$ n 3
 (3) \$ n 2 (4) \$ m 2

Directions for questions 31 to 35: Complete the following series.

31. 4, 27, 25, 343, 121, _____

- (1) 169 (2) 2197
 (3) 3197 (4) 2457

32. 11, 25, 77, 157, 473, _____

- (1) 978 (2) 1421
 (3) 949 (4) 1431

33. 12, 30, 56, 132, 182, _____

- (1) 240 (2) 300
 (3) 316 (4) 306

34. 53, 61, 71, 79, 89, _____

- (1) 91 (2) 93
 (3) 95 (4) 101

35. 19, 58, 175, 526, _____

- (1) 1578 (2) 1238
 (3) 1458 (4) 1579

Directions for questions 36 to 40: Answer the questions based on the following information.

Seven persons Jhulan, Goswami, Imran, Khan, Hayat, Fatima and Lathika are sitting in a row. The following information about the positions in which they are seated is given.

- (i) Imran is to the right of Lathika.
- (ii) Lathika has more number of persons sitting on her right than left.
- (iii) Hayat and Khan are sitting together but neither of them is sitting next to Jhulan.
- (iv) Goswami is sitting at one end of the row.
- (v) Jhulan is sitting at one of the ends.
- (vi) Fatima has equal number of persons on either side of her.

36. Who is to the immediate right of Fatima?

- (1) Hayat
- (2) Imran
- (3) Khan
- (4) Cannot be determined

37. Who is sitting at the extreme left?

- (1) Goswami
- (2) Jhulan
- (3) Lathika
- (4) Khan

38. How many persons are sitting to the left of Hayat?

- (1) Four
- (2) Five
- (3) Six
- (4) Either (1) or (2)

39. If the chairs are numbered 1 to 7 from left to right, what is the number of the chair in which Imran is sitting?

- (1) 1
- (2) 2
- (3) 3
- (4) 5

40. How many persons are sitting between Jhulan and Goswami?

- (1) 5
- (2) 3
- (3) 6
- (4) 2

Directions for questions 41 to 45: Answer the questions based on the information given below.

Five different sprinters A, B, C, D and E are running on five different tracks numbered 1, 2, 3, 4 and 5 wearing a distinct coloured dress among red, blue, green, yellow and white, not necessarily in the same order. Further, it is known that

- (i) Each one is at a different position. E is ahead of C but he is not running in track 2.
- (ii) C has as many sprinters before him as after him and he is running on track 1 wearing a red coloured dress.
- (iii) The sprinter wearing a blue coloured dress is leading the race but he is not E and he is running on track 5.
- (iv) D and A are in the last two positions and they are wearing green and yellow dresses respectively.
- (v) A is running on track 4.

41. Who is wearing a blue coloured dress?

- (1) A
- (2) B
- (3) C
- (4) D

42. Who is running on track 2?

- (1) A
- (2) B
- (3) C
- (4) D

43. The sprinter running on track 4 is wearing a _____ coloured dress.

- (1) red
- (2) blue
- (3) green
- (4) yellow

44. Which of the following combinations is correct regarding the sprinter and the dress he is wearing?

- (1) B – White
- (2) E – White
- (3) C – Green
- (4) D – Blue

45. Who is in the first position?

- (1) A
- (2) B
- (3) C
- (4) D

Directions for questions 46 to 50: Answer the questions based on the following information.

Six persons P, Q, R, S, T and U are sitting around a circular table. Each one is from a different country among Brazil, Spain, China, Paris, London and Germany. Each one has been selected to be part of the Business Tycoon Association in different year among 2001, 2002, 2003, 2004, 2006, 2008. Further, it is known that –

- (i) Q is sitting three places away from R.
- (ii) The persons from Brazil, Paris and London are sitting in consecutive positions and P is not adjacent to any one of them and they were selected to be members of the association in the years after which S is selected to be a member.
- (iii) Q and R were selected for the years 2006 and 2001, in no particular order.
- (iv) T is sitting two places away from P.
- (v) The person from China was selected for the year 2003, but he is not P and he is sitting three places away from the person from Brazil.
- (vi) The person from Brazil is sitting to the right of Q and he was not selected for the year 2008.
- (vii) The person from Spain is not sitting adjacent to the person who was selected for the year 2004.

46. Who is sitting opposite to the person from Germany?

- (1) P (2) Q
(3) R (4) T

47. The person sitting opposite to the person from Spain is from which place?

- (1) Paris
(2) London
(3) China
(4) Cannot be determined

48. Who was selected for the year 2006?

- (1) P (2) Q
(3) R (4) S

49. The person from which of the following places is adjacent to P?

- (1) Brazil (2) Spain
(3) Paris (4) Germany

50. Which among the following is a correct combination of person, place and year?

- (1) U – Paris – 2006 (2) R – London – 2008
(3) T – Spain – 2004 (4) Q – Germany – 2001

Directions for questions 51 to 55: These questions are based on the following information.

A sequence of digits and symbols and their respective letter codes are given below.

Symbols/ 1 7 8 # \$ 2 π 6 % 3 θ ϕ 4 @ 1 © * + 5 Ψ Δ
Digits:

Letter b e C d f l m o q n r p s g a t i v w x y
codes:

- (i) If the first element in the group is a symbol and the last element in the group is an even digit then mark both as 'w'.
(ii) If the first element in the group is an odd digit and the last element in the group is a symbol then interchange their respective codes.
(iii) If both the first and the last elements in the group are digits then mark both as 'z'.
(iv) If both the first and the last elements in the group are symbols then mark both as 'h'.
Find the code for the group of digits and letters given in each question based on the symbol codes and the conditions given.

51. 6 % 3 * Δ

- (1) q p n i y (2) o q n i y
(3) o q n i m (4) o q h i y

52. © 7 8 2 \$ 4

- (1) v e c i f w (2) w e c i g w
(3) w e c i f w (4) w e c l f w

53. Ψ 1 2 6 \$ Ψ

- (1) h a l e f h (2) h a l o f h
(3) h a l e g h (4) h a l a f h

54. 3 θ + % 7 ϕ

- (1) p r v q e n (2) p r q v e m
(3) p r w q e m (4) p r v q a m

55. 7 # π 1 4 2 π

- (1) m d m a s l e (2) m d n a s l e
(3) m d m a s l m (4) n d m a s l e

Directions for questions 56 to 60: Answer the following questions based on the information given below.

Two rows of numbers are given. The resultant number in each row is to be worked out separately based on the following rules. The question below the rows are to be answered.

- (1) If an odd number is followed by an odd number which is a perfect square then the second number is divided by the first number.
(2) If an odd number is followed by an odd number which is a prime number then subtract the smaller one from the larger one.
(3) If an even number is followed by an odd number which is a prime number then the two numbers are added.
(4) If a prime number is followed by a number which is neither a perfect square nor a prime number then the two numbers are multiplied.
(5) If an even number is followed by an even number then the two numbers are added.

56. 3 8 7

a 10 101

If a is the resultant of the first row, find the resultant of the second row.

- (1) 101 (2) 310
(3) 411 (4) 311

57. 2 15 6

b 13 7

If b is the resultant of the first row, find the resultant of the second row.

- (1) 42 (2) 7
(3) 49 (4) 343

58. 7 49 49

12 c 6

If c is the resultant of the first row, find the sum of the resultants of both the rows.

- (1) 114 (2) 107
(3) 7 (4) 121

59. 15 11 10

a 3 29

If a is the resultant of the first row, find the difference of the resultants of both the rows.

- (1) 20 (2) 6
(3) 2 (4) 26

60. 2 4 10

b 3 6

If b is the resultant of the first row, find the resultant of the second row.

- (1) 114
(2) 130
(3) 98
(4) 116

Directions for questions 61 to 65: Each problem contains a question and two statements which give certain data. You have to select the correct answer from (1) to (4) depending on the sufficiency of the data given in the statements to answer the question.

Mark 1: If any of the statement alone is sufficient to answer the question and the other statement alone is not sufficient to answer the question.

Mark 2: If the question can be answered by using either statement alone.

Mark 3: If statements I and II together are not sufficient to answer the question and additional data specific to the problem is needed.

Mark 4: If statements I and II together are sufficient to answer the question, but neither statement alone is sufficient.

61. P, Q, R, S and T are of different heights. Who among them is the tallest?

- I. Q is taller than at least two persons.
II. S is taller than both Q and T.

62. What is the angle between the two hands of a clock?

- I. The minute hand is exactly at 4.
II. The hour hand is exactly at 8.

63. How is Ravi related to Bhargavi?

- I. Bhargavi's father's brother's only sibling is Ravi.
II. Ravi's father's father's only grand child's wife's daughter is Bhargavi.

64. Today is which day of the week?

- I. February 3, of this year is Monday.
II. Today is the sixth day after 27th February, which is Friday.

65. In which direction is city Y with respect to city S?

- I. City S is to the South of city M, which is to the North of city Y.
II. City S is to the East of city L, which is to the East of city Y.

Directions for questions 66 to 70: In each question below are given some statements followed by some conclusions. You have to take the given statements to be true even if they seem to be at variance from commonly known facts and then decide which of the conclusions logically follow/s the given statements.

66. Statements:

Some cherries are jellies.
All jellies are strawberries.
All cherries are chestnuts.

Conclusions:

- I. All jellies are chestnuts.
II. Some jellies are chestnuts.
III. Some cherries are strawberry.
IV. All cherries are jellies.
(1) Only III follows
(2) Only I and II follow
(3) Only I and IV follow
(4) Only II and III follow

67. Statements:

Some Crimson are Red.
All White are Black.
No Red is White.

Conclusions:

- I. Some Crimson are Black.
II. Some Crimson are White.
III. All Crimson are White.
IV. Some Black are not White.

- (1) Only II and IV follow
- (2) Only IV follows
- (3) Only II and III follow
- (4) Only I and IV follow

68. Statements:

All Sugar are Salt.
Some Powder are Sugar.
All Powder are Mixture.

Conclusion:

- I. No Powder is Salt.
- II. Some Mixture are Salt.
- III. Some Sugar are Mixture.
- IV. All Mixture are Salt.
- (1) Only III follows
- (2) Only II and III follow
- (3) Only II, III and IV follow
- (4) Only I, II and III follow

69. Statements:

All Steel are Copper.
All Iron are Zinc.
No Steel is Iron.

Conclusions:

- I. Some Copper are Zinc.
- II. Some Steel are Zinc.
- III. Some Steel are not Copper.
- IV. Some Iron are not Zinc.
- (1) Only II and III follow
- (2) Only II follows
- (3) Only I, II and III follow
- (4) None follows

70. Statements:

Some Mild are Cold.
Some Cold are Hot.
All Mild are Medium.

Conclusions:

- I. Some Medium are Cold.
- II. No Cold is Medium.
- III. Some Hot are Medium.
- IV. Some Hot are not Medium.
- (1) Only I, II and IV follow
- (2) Only I follows
- (3) Only II and IV follow
- (4) Only I and II follow

Directions for questions 71 to 75: In each question below is given an Assertion followed by two Reasons numbered RI and RII. Apply reasons to the assertion and give your answers as follows.

- (1) only RI and not RII is the reason for the assertion.
- (2) only RII and not RI is the reason for the assertion.
- (3) both RI and RII are the reasons for the assertion.
- (4) neither RI nor RII is the reason for the assertion.

71. Assertion:

Students are showing great interest in taking their degrees from UK Universities with regard to management studies.

- RI. UK Universities have proved to be the best in grooming students for a career in management.
- RII. Other countries cannot provide the facilities for management courses as UK Universities provide.

72. Assertion:

In the Indian film festival, many awards have been given to Hindi movies.

- RI. Judges of film festivals know the Hindi language better than any other regional language.
- RII. Hindi is a national language.

73. Assertion:

Most of the people in metropolitan cities lead an extremely busy life.

- RI. They are interested in earning lots of money at the earliest.
- RII. Having more than one source of income is keeping these people busy.

77. Assertion:

If a cat crosses one's path, it is a bad omen.

- RI. It is believed that cat brings bad luck.
- RII. Many people had accidents after a cat crossed their path.

75. Assertion:

Insatiably curious children usually grow up to be genius.

- RI. They ask so many questions that they learn about most of the things much earlier than an average child.
- RII. Only a genius mind is full of curiosity.

Directions for questions 76 to 80: Given below are two sets of figures, the problem figures and the answer figures

marked 1, 2, 3 and 4. Which figure from 1, 2, 3 and 4 would be the next in the series of the problem figures?

76. PROBLEM FIGURES

B C D	C D A	D E A	A E B	A B C
A → E	B ↗ E	C ↑ B	D ↘ C	E ← D

ANSWER FIGURES

D B	B C D	B C A	B C A
E ↙	E ↙ A	D ↙ E	E ↙ D
A C			

(1) (2) (3) (4)

77. PROBLEM FIGURES

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ANSWER FIGURES

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(1) (2) (3) (4)

78. PROBLEM FIGURES

○ △ λ θ	θ λ △ ○	△ ○ φ ×	● = λ φ	○ ● ○ φ λ
● = φ ×	× φ = ●	λ θ ○ △	θ × △ =	△ × θ
\$ # Σ >	> Σ # \$	β 1 ! α	Σ β \$!	\$ β Σ
! α β 1	1 β α !	Σ > \$ #	> 1 # α	α # 1 >

ANSWER FIGURES

△ = θ ×	△ = θ ×	△ = > 1	θ × △ =
○ ● λ φ	○ ● λ φ	○ ● Σ β	λ φ ○ ●
# α > 1	α # > 1	# ! θ ×	> 1 # α
\$! Σ β	\$ Σ β	\$ α λ φ	Σ β \$!

(1) (2) (3) (4)

79. PROBLEM FIGURES

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ANSWER FIGURES

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(1) (2) (3) (4)

80. PROBLEM FIGURES

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ANSWER FIGURES

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(1) (2) (3) (4)

Directions for questions 81 to 85: In each of the following questions, the first two figures of the problem figures are related to each other in a certain way. Find out which figure from the answer figures (1), (2), (3) and (4), should be placed at the ? mark so that the second pair of problem figures so formed will have a similar relationship and can be placed in place of the "question mark".

81. PROBLEM FIGURES

(I)	(II)	(III) ?	(IV)
-----	------	---------	------

ANSWER FIGURES

(1)	(2)	(3)	(4)
-----	-----	-----	-----

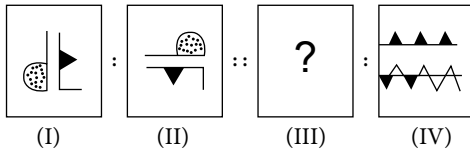
82. PROBLEM FIGURES

(I)	(II)	(III) ?	(IV)
-----	------	---------	------

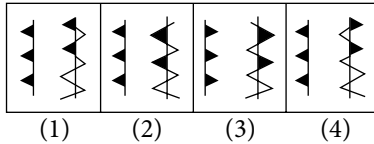
ANSWER FIGURES

(1)	(2)	(3)	(4)
-----	-----	-----	-----

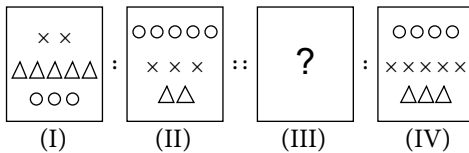
83. PROBLEM FIGURES



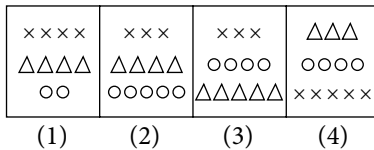
ANSWER FIGURES



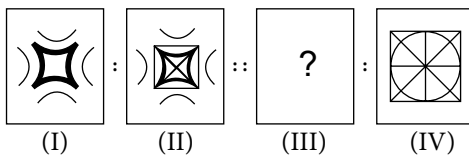
84. PROBLEM FIGURES



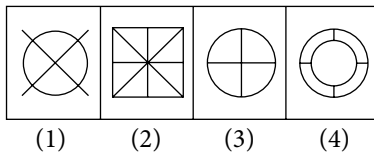
ANSWER FIGURES



85. PROBLEM FIGURES

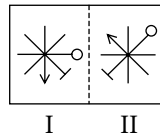


ANSWER FIGURES

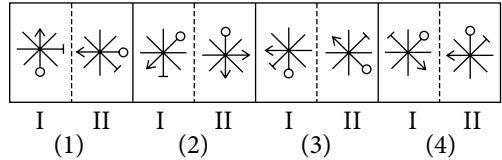


Directions for questions 86 to 90: In each of the following questions, a pair of problem figures is given at the extreme left followed by four pairs of answer figures. The figure on the left in the problem figures bears a certain relationship with the figure on the right. Out of the four pairs given in the answer figures, one should be similar to the pair given in the problem figure. Find that pair.

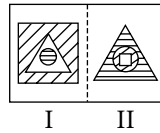
86. PROBLEM FIGURES



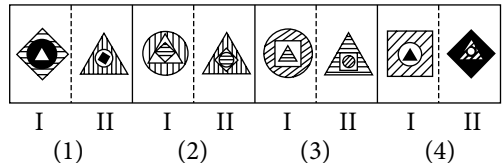
ANSWER FIGURES



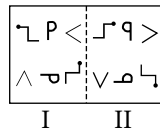
87. PROBLEM FIGURES



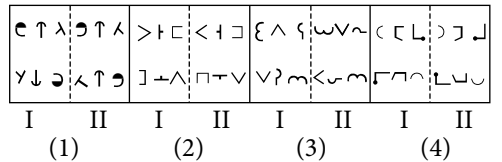
ANSWER FIGURES



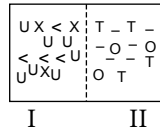
88. PROBLEM FIGURES



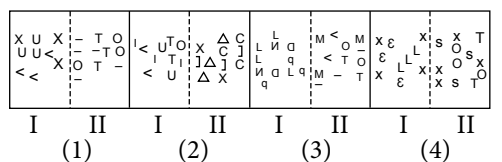
ANSWER FIGURES



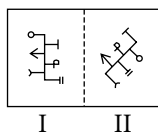
89. PROBLEM FIGURES



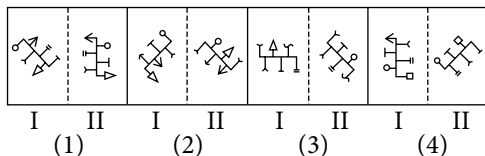
ANSWER FIGURES



90. PROBLEM FIGURES



ANSWER FIGURES



Directions for questions 91 to 180: Select the correct alternative from the given choices.

91. A vernier calipers has 20 divisions on vernier scale and its M.S.D is 0.5 mm. When a hollow cylinder is held by its internal jaws the M.S.R and V.C.D of calipers are 1.2 cm and 10 respectively. The radius of cross-section of the cylinder is _____ cm.
 (1) 0.6125 (2) 0.1325
 (3) 0.1256 (4) 0.756
92. A pendulum of 28 cm length oscillates such that its string makes an angle of 30° with the vertical when it is at one of the extreme positions. Find the ratio of the distance to displacement of the bob of the pendulum when it moves from one extreme position to the other.
 (1) 21 : 22 (2) 22 : 21
 (3) 11 : 21 (4) 21 : 11
93. A football of mass 0.5 kg moving with a velocity of 10 ms^{-1} hits a pole and the ball bounces back and moves with a velocity of 20 ms^{-1} . Find the force exerted on the ball, if the force acts for 0.02 s.
 (1) 250 N (2) 175 N
 (3) 750 N (4) 350 N
94. The momentum of a bullet of mass 0.05 kg and does a work of 1000 J on a wooden block when it hits the wooden block is _____ kg ms^{-1} .
 (1) 20 (2) 30
 (3) 10 (4) 5
95. An object is placed at a distance of 10 cm from the pole of a convex mirror of focal length 15 cm. The image distance is _____ cm.
 (1) 14 (2) 3
 (3) 12 (4) 6
96. Vinay was given a circle of radius 7 cm constructed of a uniform wire of resistance of 2 ohm per cm by his teacher. She asked him to connect it in a circuit such that it offers maximum resistance. The maximum resistance is _____ Ω .
 (1) 22 (2) 44
 (3) 88 (4) 66
97. The magnetic moment of a bar magnet is 2 A m^2 . If the magnetic length of the bar magnet is 5 cm, determine the force acting on it in an external magnetic field of strength 0.6 T.
 (1) 12 N (2) 24 N
 (3) 36 N (4) 48 N
98. A simple barometer tube contains some air in it. The length of the tube above the mercury level in the trough is 80 cm. The height of mercury in the tube is 71 cm at normal atmospheric pressure. What is the actual decrease in the atmospheric pressure if the barometer reads 65 cm?
 (1) 15 (2) 6
 (3) 9 (4) 8
99. The left arm of a manometer is connected to a container containing gas 'X' and the mercury level in the right arm is raised by 2 cm. Now without disconnecting the container of gas X, the right arm of the manometer is connected to another container containing gas 'Y' and the mercury level in the right arm is pushed down by 5 cm. The pressure exerted by the gases 'X' and 'Y' are _____ cm and _____ cm of Hg respectively.
 (1) 80, 82 (2) 86, 80
 (3) 82, 80 (4) 80, 86
100. A source of wave vibrates with a frequency 500 Hz. The wave travels 33 m in 0.1 s. How far does the waves travels when the source executes 150 vibrations?
 (1) 99 m (2) 33 m
 (3) 66 cm (4) 122 m
101. The frequency of fundamental mode of vibration of an air column enclosed in a closed end pipe is 250 Hz. If its length is 33 cm, then find the velocity of sound in air.
 (1) 340 ms^{-1} (2) 330 ms^{-1}
 (3) 320 ms^{-1} (4) 350 ms^{-1}

102. After the emission of which of the following rays the element 'X' changes to other element?

- (1) Cathode rays (2) X-rays
(3) β -rays (4) γ -rays

103. 0101000101010101010000 is the BCD code of the number _____.

- (1) 156 (2) 150
(3) 923 (4) 432

104. 100 g of LPG is combusted and all the heat produced is used to raise the temperature of certain mass of water by 50 °C. Find the mass of the water. (Specific heat capacity of water is 4.2 kJ kg⁻¹ °C⁻¹ and calorific value of LPG is 55,000 kJ kg⁻¹)

- (1) 26.2 kg (2) 2620 g
(3) 2.62 kg (4) 262 g

105. Identify the correct sequence of relevant steps to write the formula of cupric bisulphate.

- (a) Writing the symbol of negative radical as HSO_4^{-2}
(b) Writing the symbol of positive radical as Cu^{+2}
(c) Writing symbol of negative radical as HSO_4^-
(d) Writing symbol of positive radical as Cu^+
(e) Interchanging the valencies of positive and negative radicals and writing subscripts as 1 and 2.
(f) Interchanging the valencies of positive and negative radicals and writing as subscripts 2 and 1.
(g) Keeping HSO_4 in paranthesis
(h) Keeping Cu in paranthesis.
(1) b a e h (2) b c e g
(3) d c f h (4) d a f g

106. Which of the following is correct regarding condensation?

- (a) During condensation only kinetic energy decreases.
(b) During condensation potential as well as kinetic energies decreases.
(c) During condensation the temperature of the gas should be at or below its critical temperature.
(d) During condensation energy is released.
(1) (a), (b) and (c) (2) only (b)
(3) only (d) (4) (c) and (d)

107. A list of organic compounds are given below. Identify the set of compounds which have empirical formula mass same as molecular mass

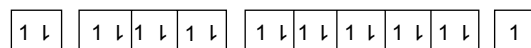
- (A) CH_3COOH (B) C_6H_6
(C) $\text{C}_2\text{H}_5\text{OH}$ (D) C_2H_4
(E) CH_3CHO

- (1) (C) and (E) (2) (A), (C) and (E)
(3) (B) and (D) (4) (A) and (E)

108. Some of the graphs plotted between different variables are given. Identify the correct ones.

- (A) The plot of V vs 1/P is a straight line passing through the origin.
(B) PV vs P is a straight line parallel to pressure axis
(C) V vs t°C is a straight line passing through the origin.
(D) V vs 1/T is a straight line passing through the origin.
(1) (A) & (B) (2) (C) & (D)
(3) (A) & (D) (4) (B) & (D)

109. Electronic configuration of an element is represented below



Identify the true statements regarding the element.

- (A) The electronic configuration of element violates Aufbau principle.
(B) The element could have atomic number 29.
(C) It corresponds to excited state configuration.
(D) The differentiating electron in next element enters into 'P' sub shell.
(E) The element cannot form stable ion.
(1) A and B
(2) A, B and E
(3) B, C and D
(4) A, D and E

110. An atom becomes stable after losing 2 electrons from 5th shell and attains an inert gas configuration. Identify the element.

- (1) Ca (2) Ba
(3) Rb (4) Sr

111. Metal 'M' is found to have 1st, 2nd, 3rd and 4th IP values as 140×5 , 162×1 , 170×3 and 284 KJ/mole respectively. The formula of the stable chloride of the metal is

- (1) MCl (2) MCl_2
(3) MCl_3 (4) MCl_4

- 112.** The electronegativity of chlorine and nitrogen is the same, but a strong hydrogen bond is present in NH_3 not in HCl because
- (1) the number of valence electrons in chlorine is more than that of nitrogen.
 - (2) there are 3 non-bonded electron pairs in HCl whereas only 1 non-bonded electron pair in NH_3 .
 - (3) the radius of nitrogen atom is more than that of the chlorine atom due to the presence of less number of protons.
 - (4) the radius of chlorine atom is more than that of nitrogen atom due to the presence of more number of orbits or shells.
- 113.** Increase in pressure does not affect the yield of the product. Which of the following reactions is associated with this observation?
- (1) Dissociation of potassium chlorate.
 - (2) Dissociation of lime stone.
 - (3) Dissociation of ammonium bisulphide.
 - (4) Dissociation of nitric oxide.
- 114.** A basic solution is found to have K_w as 10^{-16} at a particular temperature. The OH^- ion concentration of the solution at the same temperature could be _____.
- (1) 10^{-8}
 - (2) 10^{-7}
 - (3) 10^{-9}
 - (4) 10^{-12}
- 115.** Which of the following formulae does not represent a carbohydrate?
- (1) $\text{C}_6\text{H}_{12}\text{O}_6$
 - (2) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
 - (3) $\text{C}_{18}\text{H}_{32}\text{O}_{16}$
 - (4) $\text{C}_{20}\text{H}_{40}\text{O}_{18}$
- 116.** The number of sigma and pi bonds in 3-methyl-1-pentyne are _____.
- (1) $5\sigma, 2\pi$
 - (2) $15\sigma, 1\pi$
 - (3) $15\sigma, 2\pi$
 - (4) $12\sigma, 2\pi$
- 117.** When burning candle is placed in an atmosphere of chlorine it continuously burns evolving no smoke because
- (1) chlorine is combustible substance.
 - (2) chlorine has high affinity for hydrogen.
 - (3) chlorine has low affinity for hydrogen.
 - (4) chlorine is a supporter of combustion.
- 118.** The bark layer of a tree is generally impervious to gases and water, due to
- (1) Lignified cork
 - (2) Cutinised cork
 - (3) Pectinised cork
 - (4) Suberised cork
- 119.** Consider the following pairs.
1. Cuboidal epithelium – Lining of kidney tubules and ducts of salivary glands
 2. Squamous epithelium – Inner lining layer of intestine
 3. Ciliated columnar – Respiratory tract epithelium for pushing the mucus to clear the pathway
 4. Stratified squamous epithelium – Skin epithelial cells to secrete substances at the epithelial surface
- The two wrongly matched pairs are
- (1) 2 and 4
 - (2) 1 and 3
 - (3) 2 and 3
 - (4) 1 and 4
- 120.** Mycoplasma and cyanobacteria belong to the kingdom
- (1) Protista
 - (2) Fungi
 - (3) Monera
 - (4) Archaeobacteria
- 121.** From the following statements.
- A. Water-driven tube system for movement
 - B. Spiny skinned body
 - C. Hard calcium carbonate skeleton
 - D. Exclusively free-living marine habitat
- Select the correct alternative about starfishes and sea urchins.
- (1) A, B, C and D
 - (2) A, C and D
 - (3) A, B and D
 - (4) B, C and D
- 122.** Which one is a wrong statement?
- (1) Helicobacter pylori causes peptic ulcer.
 - (2) Trypanosoma is responsible for sleeping sickness disease.
 - (3) Ascaris lumbricoides is the round worm causing ascariasis.
 - (4) Staphylococci bacteria can cause SARS disease.
- 123.** Which of the followings are the reasons for the death of HIV-AIDS patients?
- (1) Small cold can become pneumonia.
 - (2) Minor gut infection can produce major diarrhoea with blood loss.
 - (3) Active immune system recruits many cells to the affected area.

- (4) More energy has to be spend for internal metabolism.

The correct alternative is

- (1) 3 and 4 (2) 1 and 2
(3) 2 and 4 (4) 2 and 3

124. The most important green house gas is

- (1) Carbon monoxide
(2) Nitrous oxide
(3) Sulphur dioxide
(4) Carbon dioxide

125. The common green manure plant used in Indian crop land is

- (1) Sun hemp (2) China rose
(3) Lentil (4) Rape seed

126. Which honey bee is showing high honey collection?

- (1) Apis dorsata
(2) Apis florea
(3) Apis mellifera
(4) Apis indica

127. In photosynthesis, the carbondioxide gets reduced by

- (1) The oxygen from water
(2) The hydrogen from water
(3) The energy from sun light
(4) The energy from chlorophyll molecules

128. In human digestion, the enzymatic activity of pepsin is facilitated by

- (1) Hydrochloric acid
(2) Mucus
(3) Renin
(4) Salivary amylase

129. The respiratory pigment seen in human being is

- (1) Myoglobin
(2) Haemozoin
(3) Anthocyanin
(4) Haemoglobin

130. Which of the followings are the consequences of high blood pressure?

- A. Constriction of arterioles
B. An increased resistance to blood flow
C. Rupture of artery
D. Internal bleeding

Select the correct alternative

- (1) A, C and D (2) A, B, C and D
(3) A, B and D (4) A and B

131. X is a number formed by the first 100 digits of the number N which is formed by writing 100 natural numbers one after another as follows 1234567891011..... Find remainder when X is divided by 16.

- (1) 3 (2) 6
(3) 9 (4) 12

132. The square root of the conjugate of $16 - 2\sqrt{60}$ is _____.

- (1) $\sqrt{10} + \sqrt{6}$ (2) $\sqrt{12} + 2$
(3) $\sqrt{14} + \sqrt{2}$ (4) $\sqrt{11} + \sqrt{15}$

133. If the speed of a vehicle decreases by 10 kmph, it takes 2 hours more than what it usually takes, to cover a distance of 1800 km. Find the time it usually takes.

- (1) 24 hours (2) 18 hours
(3) 36 hours (4) 30 hours

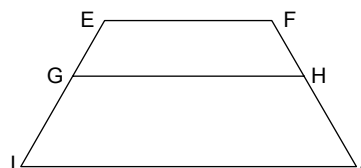
134. If $\frac{4x^2 - 9x - 9}{x^2 - 9} \leq 0$, then the solution set for the inequality is

- (1) $\left(-3, -\frac{3}{4}\right]$ (2) $\left[-3, -\frac{3}{4}\right]$
(3) $R - \left(-3, -\frac{3}{4}\right)$ (4) $\left[-\frac{3}{4}, 0\right)$

135. In ΔPQR , $\angle Q = 90^\circ$, $PQ = 5.4$ cm and $QR = 7.2$ cm. Find the length of the median drawn to PR (in cm).

- (1) 3.6 (2) 4
(3) 4.5 (4) 5

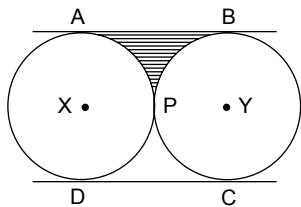
- 136.



In the figure above, $EF \parallel GH \parallel IJ$. If $EG : GI = 1 : 3$, $EF = 12$ and $IJ = 16$, find GH.

- (1) 14 (2) 13
(3) 15.5 (4) 14.5

137. In the given figure, radius of each circle is 7 cm. Find area of the shaded portion.



- (1) 42 cm² (2) 47 cm²
 (3) 64 cm² (4) 21 cm²
138. The number of distinct solutions of the equation $f(x) = 0$, where $f(x) = |x+3| + |x-3|$, $x \in \mathbb{R}$ is
- (1) 2 (2) 1
 (3) 4 (4) 0
139. A shopkeeper defrauds both the dealer and the customer by measuring weights incorrectly. When he is purchasing items from the dealer, he takes 20% more than the indicated weight and when he is selling them to the customer, he gives 20% less than the indicated weight. If the price that the shopkeeper charges his customer is the same as what the dealer charges the shopkeeper, then what profit percentage does the shopkeeper make?
- (1) 40% (2) 44%
 (3) 50% (4) 60%
140. The difference between the compound interest and the simple interest for 2 years on a sum of ₹12000 at certain rate of interest is ₹120. Find the rate of interest.
- (1) 100% p.a. (2) 110% p.a.
 (3) 10% p.a. (4) 11% p.a.
141. A geometric progression has a sum to infinity. The value of the cube of any term is 1/8th of the cube of the sum of the terms which follow it. Find the sixth term of the geometric progression if the first term is 4.
- (1) $\frac{2}{3}$ (2) $\frac{64}{81}$
 (3) $\frac{128}{243}$ (4) $\frac{256}{729}$

142. If $A = \begin{pmatrix} 0 & 5 \\ 5 & 0 \end{pmatrix}$, then $A^{81} =$

(1) $5^{81} A$ (2) $5^{80} A$
 (3) $5^{80} I$ (4) $5^{81} I$

143. Find the number of irrational terms in the expansion

$$\text{of } \left(2^{\frac{1}{2}} + 3^{\frac{1}{4}} \right)^{64}.$$

(1) 40 (2) 48
 (3) 44 (4) 52

144. If the variance of the series x_1, x_2, \dots, x_n is p , then the standard deviation of the series $2x_1 + 3, 2x_2 + 3, \dots, 2x_n + 3$ is

(1) \sqrt{p} (2) $2\sqrt{p} + 3$
 (3) $2p + 3$ (4) $2\sqrt{p}$

145. A vessel was filled with a mixture of milk and water having 90% milk. 10 litres of the solution was withdrawn from it and replaced with water. This procedure was repeated. The vessel then contained 65.61 litres of milk. Find the capacity of the vessel (in litres).

(1) 90 (2) 80
 (3) 120 (4) 150

146. How many different words can be formed using all the letters of the word TRINETRA?

(1) 20160 (2) 40320
 (3) 5040 (4) 10080

147. A five letter word is formed with the letters $\{a, e, i, p, q, r\}$. How many of them are palindromes?

(1) 196 (2) 210
 (3) 180 (4) 216

148. One square is selected from an 8×8 chess-board. What is the probability that it is a square of size 2×2 ?

(1) $\frac{51}{204}$ (2) $\frac{49}{204}$
 (3) $\frac{25}{102}$ (4) $\frac{13}{27}$

149. The equation of the perpendicular bisector of PQ is $3y + x - 34 = 0$. If $P(2, 4)$, then find Q.

(1) (6, 16) (2) (3, 7)
 (3) (4, 10) (4) (5, 13)

150. $(\cot 40^\circ + \cot 50^\circ)(\sec 40^\circ \sec 50^\circ) =$

- (1) $\frac{1}{\sin^2 40^\circ}$ (2) $\frac{1}{\sin^2 80^\circ}$
 (3) $\frac{4}{\sin^2 80^\circ}$ (4) $\frac{4}{\sin^2 40^\circ}$

151. In which of the following year was Project Tiger launched in India?

- (1) 1973 (2) 1972
 (3) 1983 (4) 1974

152. What percentage of area of Andaman and Nicobar Island is covered with forests approximately?

- (1) 84.9% (2) 86.9%
 (3) 88.9% (4) 92.9%

153. Bamboo drip irrigation is common in the state of

- (1) Rajasthan
 (2) Madhya Pradesh
 (3) Meghalaya
 (4) Karnataka

154. What is the basic cause of new social movements like the Narmada Bacho Andolan and Tehri Dam Andolan?

- (1) The dams built on these rivers will provide power only to cities
 (2) Many industries will be sub-merged under these dams
 (3) A large scale of displacement of local communities
 (4) None of these

155. Which one of the following minerals is formed by decomposition of rocks, leaving a residual mass of weathered material?

- (1) Coal (2) Bauxite
 (3) Gold (4) Zinc

156. The largest solar plant of India is located at

- (1) Madhapur near Bhuj.
 (2) Nagarcolli in Tamil Nadu.
 (3) Madurai in Tamil Nadu.
 (4) None of these

157. How many aluminium smelting plants are there in India?

- (1) 6 (2) 8
 (3) 10 (4) 12

158. India has inland navigation water ways of _____ km in length.

- (1) 14300 (2) 14700
 (3) 14500 (4) 14900

159. Why do western slopes of Western Ghats receive Orographic rainfall?

- (1) Due to the facing slopes of the south-west monsoons
 (2) Due to western disturbances
 (3) Due to tropical cyclones
 (4) Due to conventional rainfall

160. Kalahatti waterfalls and Indian Botanical Gardens are located in

- (1) Seshachalam Hills
 (2) Ooty
 (3) Ratnagiri Hills
 (4) None of these

161. GDP means

- (1) the total goods and services produced by primary sector.
 (2) the goods produced by secondary sector.
 (3) the total production of goods and services of tertiary sector.
 (4) the total goods and services produced in all three sectors.

162. Mixed economy has fear of

- (1) nationalization
 (2) urbanization
 (3) localization
 (4) None of these

163. The price rise in India is due to the result of imbalance between

- (1) demand and supply of goods.
 (2) demand and supply of services.
 (3) demand and supply of labour.
 (4) Both (1) and (2)

164. Bureau of Indian Standards (BIS) was created as National Standards Body in

- (1) 1985 (2) 1986
 (3) 1987 (4) 1988

165. Globalization means

- (1) integrating the economy with world economy.
 (2) disintegrating the economy with world economy.

- (3) economically dependent at the global level.
(4) None of these
- 166.** Which of the following events was not associated with the Partition of Bengal?
(1) Rise of slogan of 'Vande Mataram'
(2) Organization of Bengal Swadeshi Chemical stores
(3) Six years imprisonment to Tilak
(4) Launch of Home rule movement by Annie Besant
- 167.** What was the issue of controversy among the leaders of Indian National Congress after 1919 Act and resulted in its split?
(1) Entry of Indians into the legislative councils
(2) Reservations for depressed classes
(3) Separate electorates for Muslims
(4) Separate electorates for Muslims
- 168.** Which of the following issues can not be attributed to the successful settlement of disputes by League of Nations?
(1) Dispute between Turkey and Britain
(2) Dispute between Poland and Lithuania
(3) Boundary dispute between Greece and Bulgaria
(4) Boundary dispute between Germany and Poland
- 169.** Identify the event contemporary to World war II.
(1) Emergence of USSR after Bolshevik Revolution
(2) Formation of Communist Government in China
(3) Partition of Indian Union into India and Pakistan
(4) Invasion of Indonesia by Japan
- 170.** The famous Cape of Good Hope of Africa came under the colonial control of which European country?
(1) Brazil
(2) Portugal
(3) France
(4) England
- 171.** What was the reason behind the invasion of China by Japan?
(1) Involvement of China in the internal affairs of Korea
(2) Japan's desire to occupy Manchuria
(3) Involvement of China in the internal affairs of Japan
(4) Japan's desire to dominate in Opium trade in China
- 172.** What was meant by "Laissez Fare" policy followed by the England Government?
(1) Trade controlled by Government
(2) International trade with colonies via sea routes
(3) Liberal trade with other countries
(4) Trade involving heavy taxation
- 173.** Match the entries in Column I with those in Column II.
- | Column I | Column II |
|------------------------|---------------------------|
| (A) Huang Hoe river | (a) Roman civilization |
| (B) Danube river | (b) American civilization |
| (C) Tiber river | (c) Chinese civilization |
| (D) Honderas river | (d) Greek civilization |
| (1) A-d; B-c; C-b; D-a | (2) A-d; B-a; C-b; D-c |
| (3) A-c; B-d; C-a; D-b | (4) A-c; B-a; C-d; D-b |
- 174.** What was the meaning of 'Dellas' with regard to Greek civilization?
(1) The union formed by the states to protest against the supremacy of Athens
(2) The union formed by the Greek city states under Athens to fight against Persian invasions
(3) System of Government developed in Greek State of Sparta
(4) The democratic form of Government established in Athens
- 175.** Which of the following statements was false regarding the Protestant Reformation movement in Europe?
(1) The movement first started in England and France
(2) In Germany, the movement was led by Martin Luther
(3) In Switzerland, John Calvin gave a new doctrine of life
(4) "Indulgence certificates" through Tetzel were issued by Pope in France
- 176.** Name the city which was chosen as the headquarters for European Union.
(1) Berlin
(2) Paris
(3) Ben
(4) Brussels
- 177.** Which of the following countries does not represent 'coming together type of federation'?
(1) Switzerland
(2) Spain
(3) Australia
(4) USA

178. Name the first linguistic state formed in independent India.

- (1) Andhra Pradesh (2) Maharashtra
(3) Karnataka (4) Bengal

179. Which of the following conditions has to be satisfied by a party to be recognized as a national party?

- (1) Participation in 3 consecutive Lok Sabha elections
(2) Gaining 6% of valid votes in 4 Lok Sabha constituencies

(3) Gaining of 6% valid votes in Lok Sabha or assembly constituencies in 4 states

(4) Winning at least 1 Loksabha seat each in 4 states

180. Which of the following was the basic ideological difference for the split in Indian National Congress to form nationalist congress party?

- (1) Reservations to minorities
(2) High offices of Government to natural citizens
(3) Womens' reservation bill
(4) Subsidies to poorer sections

ANSWER KEYS

MOCK TEST

1. 2	2. 4	3. 3	4. 4	5. 2	6. 4	7. 4	8. 1	9. 4	10. 4
11. 1	12. 4	13. 2	14. 2	15. 3	16. 4	17. 2	18. 4	19. 3	20. 4
21. 4	22. 2	23. 3	24. 4	25. 2	26. 3	27. 2	28. 4	29. 1	30. 4
31. 2	32. 3	33. 4	34. 4	35. 4	36. 4	37. 2	38. 4	39. 3	40. 1
41. 2	42. 4	43. 4	44. 2	45. 2	46. 3	47. 4	48. 3	49. 4	50. 4
51. 2	52. 4	53. 2	54. 1	55. 1	56. 3	57. 1	58. 4	59. 3	60. 1
61. 3	62. 1	63. 2	64. 1	65. 1	66. 4	67. 2	68. 2	69. 4	70. 2
71. 3	72. 4	73. 3	74. 2	75. 1	76. 2	77. 3	78. 1	79. 4	80. 2
81. 1	82. 2	83. 4	84. 2	85. 3	86. 4	87. 2	88. 4	89. 2	90. 1
91. 1	92. 2	93. 3	94. 3	95. 4	96. 1	97. 2	98. 4	99. 4	100. 1
101. 2	102. 3	103. 2	104. 1	105. 2	106. 3	107. 1	108. 1	109. 1	110. 4
111. 3	112. 4	113. 4	114. 2	115. 4	116. 3	117. 2	118. 4	119. 1	120. 3
121. 1	122. 4	123. 2	124. 4	125. 1	126. 3	127. 2	128. 1	129. 4	130. 2
131. 3	132. 1	133. 2	134. 1	135. 3	136. 2	137. 4	138. 4	139. 3	140. 3
141. 3	142. 2	143. 2	144. 4	145. 1	146. 4	147. 4	148. 2	149. 1	150. 3
151. 1	152. 2	153. 3	154. 3	155. 2	156. 1	157. 2	158. 3	159. 1	160. 2
161. 4	162. 1	163. 4	164. 3	165. 1	166. 4	167. 1	168. 1	169. 4	170. 4
171. 1	172. 3	173. 3	174. 2	175. 4	176. 4	177. 2	178. 1	179. 3	180. 2

SOLUTIONS

MOCK TEST

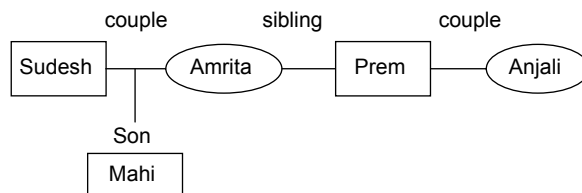
Solutions for questions 1 to 22:

- The given sequence is ____
d 6 e # 9 a b c 7 ϕ Δ 3 @ 4 t z \$ 2 i x y # ∇ % 8 u m
p 5 9, 2 and 8 are such digits. **Choice (2)**
- Bill > Jill, Nill
Jill > Tim
Din > Bill
Possibilities
Din > Bill > Jill > Nill > Tim
Din > Bill > Nill > Jill > Tim
Din > Bill > Jill > Tim > Nill **Choice (4)**
- All except, Mumbai are capital cities of a country. **Choice (3)**
- Bat is used in Cricket, Racquet is used in Tennis. **Choice (4)**
- The pattern followed in each group is as follows.
 $D^{+3} G^{-2} E$, $P^{+3} S^{+2} U$, $M^{+3} P^{-2} N$, $B^{+3} E^{-2} C$, $K^{+3} N^{-2} L$
Except PSU rest follow similar pattern. **Choice (2)**
- The pattern is as follows
1st letter in each pair: p^{+3} , S^{+3} , V^{+3} , $\underline{Y^{+3}}$ B
2nd letter in each pair: M^{+4} , Q^{+4} , U^{+4} , $\underline{Y^{+4}}$, C
3rd letter in each pair: J^{+5} , O^{+5} , T^{+5} , $\underline{Y^{+5}}$ E
 \therefore The missing terms is YYY. **Choice (4)**
- If B is a female then B's daughter's mother is B.
B's mothers daughter is B herself (\because She doesn't have any sisters) So A is B.
(or)
If B is a male then B's daughters mother is B's wife
whose mothers daughter is A (\because she doesn't have any sisters). So A is the wife of B. **Choice (4)**
- Bhujbal's father's wife's mother-in-law is Bhujbal's father's mother, whose only child is Bhujbal's father. Hence, the person in the photograph is Bhujbal's

father. Bhujbal's father is Sudha's mother's brother's only brother-in-law, i.e., Sudha is Bhujbal's father's daughter.

\therefore Bhujbal is Sudha's brother. **Choice (1)**

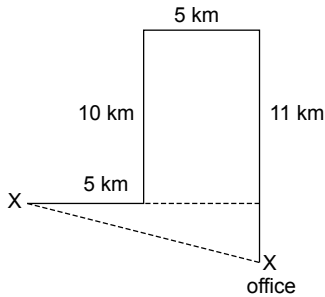
- The given relations can be represented as follows.



Mahi is Prem's sister's son, i.e., nephew. **Choice (4)**

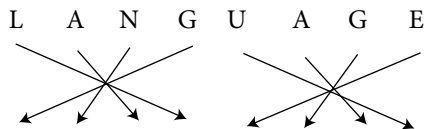
- Rahul's sister's husband's father-in-law is Rahul's father. Rahul's father's only daughter-in-law can be Rahul's wife or wife of Rahul's brother (if Rahul is unmarried). So there is no definite relationship between her son and Rahul. **Choice (4)**
- From the given information,
Chennai > Mumbai, Chennai > Hyderabad,
Hyderabad > Delhi > Mumbai
Combining the above we get,
Chennai > Hyderabad > Delhi > Mumbai.
 \therefore Mumbai is the coolest. **Choice (1)**
- S A C R I L E G E
A C E E G I L R S
There is no such letter. **Choice (4)**
- B covers 70 mins for every hour. Hence, until 7:00 pm on the day it will cover 7 hrs
 $\Rightarrow 7 \times 60 = 420$ min
B covers 70 min for every 60 min
420 min \rightarrow
 $\frac{420 \times 60}{70} = 360$ min = 6 hrs.
Hence, the actual time is 6 pm on the day. In these 6 hours A loses $6 \times 10 = 60$ min.
Hence, the time shown by A is 5 pm. **Choice (2)**

14. The path traced can be represented as follows:



The distance from the house to the office = $\sqrt{10^2 + 1^2} = \sqrt{101} \approx 10$ km. His office is in the South-east direction. **Choice (2)**

15. Word:



Logic: +1 +1 +1 +1 +1 +1 +1 +1
Code: H O B M F H B V

So the code for DISTRICT is UTJEUDJS. **Choice (3)**

16. Word: A N S W E R

Logic: +1 +2 +3 +4 +5 +6

Code: B P V A J X

Similarly

Word: C H O I C E

Logic: +1 +2 +3 +4 +5 +6

Code: D J R M H K

So the code for MINUTE is NKQYYK. **Choice (4)**

17. Word: P A P E R

Logic: +1 -1 +1 -1 +1

Code: Q Z Q D S

Word: P E N C I L

Logic: +1 -1 +1 -1 +1 -1

Code: Q D O B J K

Similarly code of SCIENCE is TBJDOBF. **Choice (2)**

18. Word: A R R A N G E M E N T

Logic: All the vowels followed by constants in ascending order.

Code: A A E E G M N N R R T

Similarly DETAILED is coded as AEEIDDLT and the code for NUMBER is EUBMNR. **Choice (4)**

19. Crocodile and Lizards are different types of reptiles.

Figure (3) best represents the relationship. **Choice (3)**

20. All peacocks are birds and all birds are living things. Figure (4) is the suitable option. **Choice (4)**

21. Trains, cars and buses are three different types of vehicles. Option (4) is the most suitable. **Choice (4)**

22. Some aunts are mothers and all mothers and aunts are females.

Option (2) is most suitable. **Choice (2)**

Solutions for question 23 to 26:

23. The numbers are expressed as given below

$$12 \rightarrow 1 + 2 = 3 \rightarrow 3^2 = 9$$

Similarly $25 - 49, 24 - 36$

The above pattern is not followed in choice (3). **Choice (3)**

24. The numbers can be expressed as given below:

$$28 = 3^3 + 1$$

$$126 = 5^3 + 1$$

$$344 = 7^3 + 1$$

$$218 = 6^3 + 2$$

Choice (4)

25. All except 2038 are divisible by 4. **Choice (2)**

26. All except 105 are prime numbers. **Choice (3)**

Solutions for questions 27 to 30:

27. After ignoring the symbols, the new sequence is –

y 9 a b c e f 6 3 t m g q n 8 2 p 4 5 h 7

7th element from the right end $\rightarrow 8$

6th element to the left of 8 $\rightarrow 3$

5th element to the right of 3 $\rightarrow n$.

or

$\leftarrow \leftarrow \rightarrow \leftarrow$

$$7 + 6 - 5 = 8$$

8th element from the right is n. **Choice (2)**

28. The given sequence is –

y 9 λ a b c e f 6 \$ 3 t φ m # g q n 8 Δ 2 p 4 \$ 5 % h 7

b, c, e and q are the letters which are immediately preceded and followed by a letter. **Choice (4)**

29. m φ t 3 \$ 6 f e c b a λ 9 y # g q n 8 Δ 2 p 4 \$ 5 % h 7.

10th element from the right end $\rightarrow 8$

4th element to the left of '8' $\rightarrow \#$.

Or

$\leftarrow \leftarrow \leftarrow$

$10 + 4 = 14$ i.e., 14th from right i.e., # **Choice (1)**

30. $a^{+2}, c^{+2}, f^{+2}, \underline{\$^{+2}}, t$. $f^{+2}, \$^{+2}, t^{+2}, \underline{m^{+2}}, g$. $t^{+3}, \#^{+3}, n^{+3}, \underline{2^{+3}}, \$$ The missing term is $\$m2$.**Choice (4)****Solutions for questions 31 to 35:**

31. The given series can be expressed as follows:

 $2^2, 3^3, 5^2, 7^3, 11^2$ where 2, 3, 5, 7, 11 are prime numbers. The next in the series is $13^3 = 2197$ **Choice (2)**

32. The given series can be expressed as follows:

 $(11 \times 2) + 3 = 25; (25 \times 3) + 2 = 77; (77 \times 2) + 3 = 157$
 $(157 \times 3) + 2 = 473; (473 \times 2) + 3 = 949$ **Choice (3)**

33. The given series can be expressed as follows:

 $3^2 + 3, 5^2 + 5, 7^2 + 7, 11^2 + 11, 13^2 + 13$ with 3, 5, 7, 11, 13 being prime numbers. The next number in the series is $17^2 + 17 = 289 + 17 = 306$ **Choice (4)**34. The given series is the series of alternate prime numbers. The next in the series is 101. **Choice (4)**

35. The given series can be expressed as

 $6 \times 3 + 1 = 19; 19 \times 3 + 1 = 58; 58 \times 3 + 1 = 175$
 $175 \times 3 + 1 = 526; 526 \times 3 + 1 = 1579$ **Choice (4)****Solutions for questions 36 to 40:**

From the given information, we can arrange the seven people as follows:

GO/JH			Fatima			GO/JH
1	2	3	4	5	6	7

Lathika has more people to her right than left, hence Lathika can be in chair 2 or 3. Hayat and Khan are always in seats 5 and 6 (in any order). As Jhulan cannot sit next to either Hayat or Khan, Jhulan sits on the extreme left in chair 1.

Hence Goswami sits on the extreme right in chair 7.

As Imran is not to the left of Lathika, he sits to her right on chair 3.

 \therefore Lathika sits in chair 2.

The final arrangement is as follows.

Jhulan Lathika Imran Fatima Hayat/Khan

1 2 3 4 5

Hayat/Khan Goswami

6 7

36. Either Hayat or Khan can sit to the right of Fatima.

Hence it cannot be determined. **Choice (4)**37. Jhulan is sitting at the extreme left. **Choice (2)**

38. Either four or five persons are to the left of Hayat.

Choice (4)39. If the chairs are numbered 1 to 7 from left to right, Imran sits in chair 3. **Choice (3)**40. There are exactly five persons sitting between Jhulan and Goswami. **Choice (1)****Solutions for questions 41 to 45:**

From (ii) it is clear that C is in the third person he is running in track 1 wearing a red coloured dress.

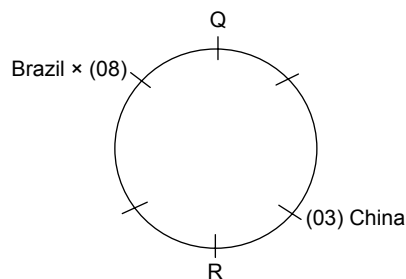
From (iii) and (i) it is clear that E is in the second position.

From (iv) it is clear that B is in the first position and the final arrangement is as follows:

B	1st position	Track - 5	Blue
E	2nd position	Track - 3	White
C	3rd position	Track - 1	Red
A	4th/5th position	Track - 4	Yellow
D	5th/4th position	Track - 2	green

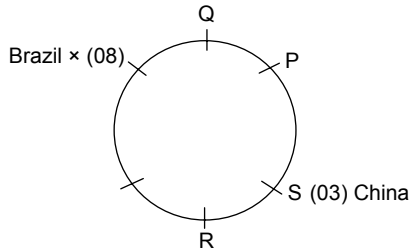
41. B is wearing a blue coloured dress. **Choice (2)**42. D is running on track 2. **Choice (4)**43. A is running on track 4 and he is wearing a yellow coloured dress. **Choice (4)**44. E – White is true. **Choice (2)**45. B is in the first position from the front end of the row. **Choice (2)****Solutions for questions 46 to 50:**

From (i), (v) and (vi) we get,



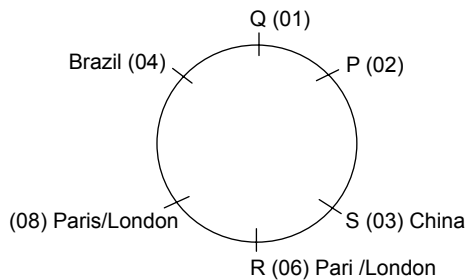
From (ii) and (v), as persons from Brazil, Paris & London are sitting together, and P is not adjacent to any of them, P can be only to the left of Q.

∴ These 3 persons got selected after S who was selected in 2003.

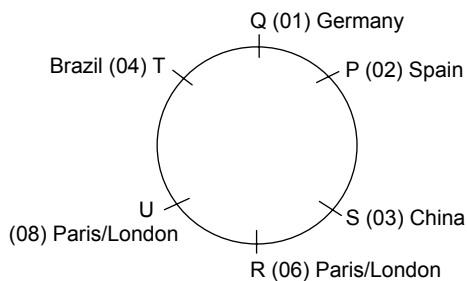


From (iii) and (ii):

As given in (ii), S got selected after 2003, thus R was selected in 2006 and Q in 2001, combining the above information with (iv).



From (vii), we get the following final arrangement.



46. R is sitting opposite to the person from Germany. **Choice (3)**
47. U is opposite to the person from Spain and he is from Paris or London. **Choice (4)**
48. R was selected for the year 2006. **Choice (3)**
49. Q who is from Germany is adjacent to P. **Choice (4)**
50. Only Choice (4) is the correct combination. **Choice (4)**

Solutions for questions 51 to 55:

51. $6 \% 3 * \Delta$
It does not follow the given conditions, hence the code is 'o q n i y' **Choice (2)**

52. © 7 8 2 \$ 4

It follows condition (i), hence the code is 'w e c l f w' **Choice (4)**

53. $\Psi 1 2 6 \$ \Psi$

It follows condition (iv), hence the code is 'h a l o f h'. **Choice (2)**

54. $3 \theta + \% 7 \phi$

It follows condition (ii), hence the code is 'p r v q e n' **Choice (1)**

55. $7 \# \pi 1 4 2 \pi$

It follows condition (ii), hence the code is 'm d m a s l e'. **Choice (1)**

Solutions for questions 56 to 60:

56. Row 1: 3 8 7
By (4) and (3) we have $3 \times 8 + 7 = 31 = a$
Row 2: 31 10 101
By (4) and (3) we have $31 \times 10 + 101 = 411$. **Choice (3)**

57. Row 1: 2 15 6
By (4) and (5) $= 2 \times 15 + 6 = 36 = b$
Row 2: 36 13 7
By (3) and (2) $= 36 + 13 - 7 = 42$. **Choice (1)**

58. Row 1: 7 49 49
By (1) we have $49/7 = 7$, again $49/7 = 7$.
Row 2: 12 7 6
By (3) and (4) we have $(12 + 7) \times 6 = 114$.
Sum of the two rows $= 7 + 114 = 121$ **Choice (4)**

59. Row 1: 15 11 10
By (2) and (5) we have $(15 - 11) + 10 = 14 = a$
Row 2: 14 3 29
By (3) and (2) we have $(14 + 3) \sim 29 = 12$.
Difference of the resultants of both the rows $= 14 - 12 = 2$. **Choice (3)**

60. Row 1: 2 4 10
By (5) we have $2 + 4 + 10 = 16 = b$
Row 2: 16 3 6
By (3) and (4) we have $(16 + 3) \times 6 = 114$. **Choice (1)**

Solutions for questions 61 to 65:

61. From I alone, we do not know if anyone is taller than Q or not. We know that Q is the tallest or the second tallest or the third tallest. Hence, I alone is not sufficient.

From II alone, we know that neither Q nor T is the tallest. Any one among P, R and S can be the tallest. Hence, II alone is not sufficient.

By combining I and II, we know that not more than two persons are taller than Q and S is one among them. We have no information regarding P and R.

∴ the question cannot be answered using both of them also. **Choice (3)**

62. To find the angle, we should know the positions of the hour hand and the minutes hand. From I alone, we do not know the position of the hour hand. Hence, I alone is not sufficient. From II alone, the hour hand is exactly at 8, which implies that the time is 8 o'clock i.e., the minutes hand is at 12. The angle between the two hands can be determined.

∴ II alone is sufficient. **Choice (1)**

63. From I alone, Bhargavi's father's brother's only sibling is Bhargavi's father i.e., Ravi is Bhargavi's father. Hence, I alone is sufficient.

From II alone, Ravi's father's father's only grand child is Ravi. Ravi's wife's daughter is Ravi's daughter i.e., Ravi is Bhargavi's father. Hence, II alone is sufficient.

∴ Either I or II is sufficient. **Choice (2)**

64. From I alone, we do not know the date of today. Hence, I alone is not sufficient. From II alone, today is the sixth day after Friday. Here the date is not required. The sixth day after Friday is Thursday.

∴ II alone is sufficient. **Choice (1)**

65. From I alone, we get the following arrangements.

(i) M	(ii) M
I	I
S	Y
I	I
Y	S

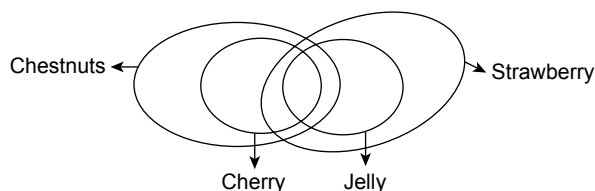
Hence, I alone is not sufficient.

From II alone, we get only one arrangement Y – L – S.

Hence, II alone is sufficient. **Choice (1)**

Solutions for questions 66 to 70:

66. The given statements can be represented as



From the above conclusion

I is affirmative, and does not follow.

II is affirmative and follows.

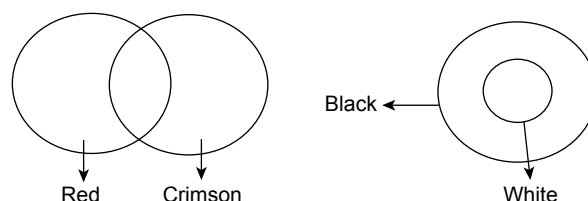
III is affirmative, and follows.

IV is affirmative, and does not follow.

Only II and III follow.

Choice (4)

67. The given statements can be represented as



From the above conclusion

I is affirmative, and does not follow.

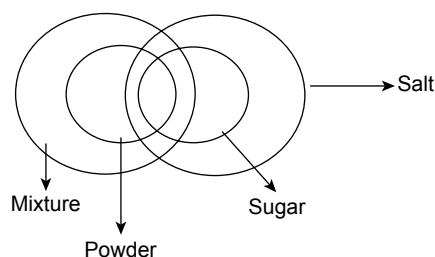
II is affirmative and does not follow.

III is affirmative and does not follow.

IV is affirmative and follows.

Choice (2)

68. The given statements can be represented as



From above, the conclusion

I is negative, and does not follow.

II is affirmative, and follows.

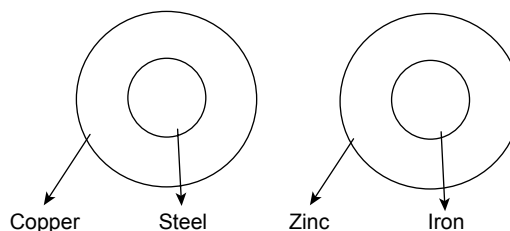
III is affirmative, and follows.

IV is affirmative, and does not follow.

Hence II and III follow.

Choice (2)

69. The given statements can be represented as



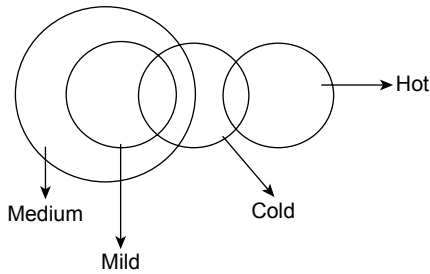
From above, the conclusion

- I is affirmative, and does not follow.
- II affirmative and does not follow.
- III negative and does not follow.
- IV negative and does not follow.

∴ None follows.

Choice (4)

70. The given statements can be represented as follow.



From above, the conclusion

- I is affirmative, and follow.
- II is negative, and does not follow.
- III is affirmative, and does not follow.
- IV is negative, and does not follow.

Hence, only I follows.

Choice (2)

71. A student may prefer a university considering the structure of academics of the facilities offered. Hence, both RI and RII are valid reasons. **Choice (3)**

72. The only reason behind getting an award can be outstanding performance. Hence, RI and RII are not valid reasons behind Hindi films getting many awards. **Choice (4)**

73. RI suggests the mad rush among people to earn more money in less time, owing to which they are busy. RII suggests that because of the availability of many sources of income, people become busy encashing them. Hence, both I and II are valid reasons. **Choice (3)**

74. RI is not valid, as it talks about the cat itself and the assertion is about a cat crossing someone's path. RII can be a valid reason. As the assertion is more of a superstition, which in all probability is based on some collection of bad events in the same regard, hence only II is the reason. **Choice (2)**

75. RI can be a valid reason because it explains the process by which a child becomes a genius. RII is invalid because we cannot say that "Only a genius mind is curious." **Choice (1)**

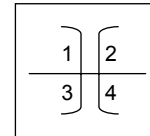
Solutions for questions 76 to 80:

76. Step 1: The element pointed by arrow is not changing its position while the other elements are cyclically shifted in an anti-clockwise direction and the arrow is rotated by 45° in an anti-clockwise direction.

Step 2: Figure (2) follows the same pattern.

Choice (2)

77. Let us number the elements and observe their movement.



Element 1, is rotated by 90° in clockwise direction

Element 2, is rotated by 0° and 90° alternately in an anti-clockwise direction.

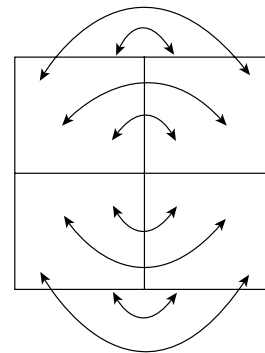
Elements 3 and 4 interchange their positions.

The similar pattern is observed in figure (3).

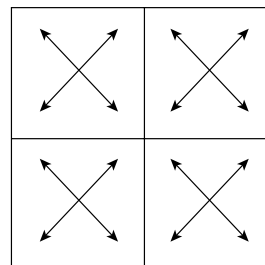
Choice (3)

78. Let us consider the following figure to understand the movement of the elements.

Step 1:



Step 2:



Elements are interchanging their positions as shown in the above figure.

Step 3:

In each box the elements are moving one step in clockwise direction.

The above three steps are repeated, figure (1) follows the same pattern. **Choice (1)**

79. In step 1, the mirror images of 'Y' and 'O' are considered and they interchange their places. At the same time the water image of the other element is considered. In step 2, the mirror image of 'O' and 'I' are considered and they interchange their places while the water image of the other element is considered. The above two steps are repeated alternately and figure (4) follows the series.

Choice (4)

80. In step 1, the top two elements' water image is considered while the other elements are cyclically shifting to their next position in the clockwise direction. In step 2, the bottom two elements' water image is considered while the other elements are cyclically shifting to their next position in clockwise direction. The above two steps are repeated alternately thus figure (2) follows the series.

Choice (2)

Solutions for questions 81 to 85:

81. Since the question mark is in figure (iii), let us compare figure (i) with figure (ii).

The shaded elements are appearing as unshaded elements and the sides of the other elements are appearing as individual elements. The same is true if the first figure is considered.

Choice (1)

82. Since the question mark is in figure (iii), let us compare figure (i) with figure (ii).

The other elements are shifting their position as shown below.

$\$ \rightarrow \theta \rightarrow - \rightarrow \alpha \rightarrow @ \rightarrow$ shifted half side to the left.

remained in its place.

Choice (2)

83. Since the question mark is in figure (iii), let us compare figure (i) with figure (ii).

The water image of both the elements are rotated by 90° in a clockwise direction. The same is true if the fourth figure is considered.

Choice (4)

84. Since the question mark is in figure (iii), let us compare figure (i) with figure (ii).

In fig (ii), the number of elements is as follows.

$$0 \rightarrow 5, X \rightarrow 3 \text{ and } \Delta \rightarrow 2$$

The rows shift upward and the elements take the number which is the same as the number of another element as follows.

$$\Delta \rightarrow 0 \rightarrow X \rightarrow \Delta$$

A similar relation can be established by taking the second answer figure. **Choice (2)**

85. Since the question mark is in figure (iii), let us compare figure (i) with figure (ii).

The square with the diagonals is missing. So the third figure should come in place of the question mark.

Choice (3)

Solutions for questions 86 to 90:

86. The elements shift their positions as follows.

'O' shifts one position in an anti-clockwise direction.

'-' shifts two positions in a clockwise direction.

'^' shifts three positions in a clockwise direction.

A Similar relation is found in the four pair.

Choice (4)

87. The inner element shifted to the second position, the second element shifted to the outer position and the outer element shifted to the inner position. The shade in the circle shifted to the triangle, the shade of the triangle shifted to the quadrilateral and the shade of the quadrilateral shifted to the circle. A similar pattern is found in the second pair of figures.

Choice (2)

88. The second figure is obtained by taking the mirror images of the top row elements and water images of the bottom row elements. A similar relation is found in the four answer figure.

Choice (4)

89. The number of elements in the second figure is the same as the number of elements in the first figure. A similar relation is found in the second answer figure.

Choice (2)

90. The two elements at the top interchanged their positions. The remaining four elements changed positions cyclically among themselves. The entire figure is rotated by 45° in a clockwise direction. A similar relation is found in the first answer figure.

Choice (1)

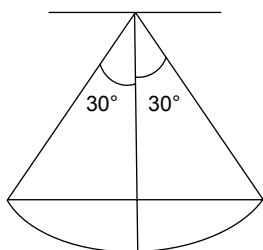
Solutions for questions 91 to 150:

$$\begin{aligned}
 91. \text{ L.C.} &= \frac{1 \text{ M.S.D}}{\text{Number of vernier scale divisions}} \\
 &= \frac{0.5 \text{ mm}}{20} = \frac{1}{40} \text{ mm} = \frac{1}{400} \text{ cm} \\
 \text{Total reading} &= \text{M.S.R} + (\text{V.C.D} \times \text{L.C}) \\
 &= 1.2 + \left(10 \times \frac{1}{400} \right) = 1.225
 \end{aligned}$$

$$\therefore \text{ radius} = 0.6125 \text{ cm}$$

Choice (1)

92. As shown in the diagram



displacement = AB

 ΔOAB is equilateral triangle.

Displacement = 28 cm

----- (1)

Distance = arc ACB

$$= \frac{60^\circ}{360^\circ} \times 2\pi r$$

Substituting $r = 28$ cm,

$$\pi = \frac{22}{7}$$

$$\text{Distance} = \frac{60}{360} \times 2 \times \frac{22}{7} \times 28 = \frac{88}{3} \text{ cm}$$

$$\begin{aligned}
 \text{Ratio of distance to displacement} &= \frac{88}{3} \times \frac{1}{28} \\
 &= \frac{22}{21} = 22 : 21
 \end{aligned}$$

Choice (2)93. Given mass of the ball, $m = 0.5$ kg.Initial velocity, $u = -10 \text{ ms}^{-1}$ (Directions are reversed)Final velocity, $v = +20 \text{ ms}^{-1}$ Time, $t = 0.02$ s

$$\text{Impulse} = mv - mu = m(v - u) = 0.5(20 + 10) = 0.5 \times 30 = 15 \text{ kg ms}^{-1}$$

$$\text{Force} = \frac{mv - mu}{t} = \frac{15}{0.02} = 750 \text{ N}$$

Choice (3)94. Mass of bullet, $m = 0.05$ kgK E of the bullet $\text{K E} = 1000 \text{ J}$

$$\text{We know, } \text{K E} = \frac{P^2}{2m}$$

Where P = momentum of the bullet

$$P^2 = (2m)(\text{KE}) = 2 \times 0.05 \times 1000 = 0.1 \times 1000 = 100$$

$$P = \sqrt{100} = 10 \text{ kg ms}^{-1}$$

Choice (3)95. In the given problem, object distance, $u = -10$ cm, (By using Cartesian sign convention)Focal length of a convex mirror, $f = +15$ cm. (By sign convention)

$$\begin{aligned}
 \frac{1}{f} &= \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} \\
 &\Rightarrow \frac{1}{v} = \frac{1}{15} - \frac{1}{-10};
 \end{aligned}$$

$$v = \frac{150}{25} = 6 \text{ cm.}$$

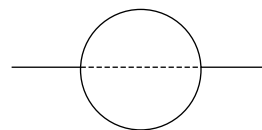
Positive sign indicates that the image is virtual.

$$\text{Magnification} = \frac{-v}{u} = \frac{-6}{-10} = 0.6$$

Since m is positive and less than one, the image is erect and diminished. An erect, virtual, and diminished image is formed at 6 cm from the pole.**Choice (4)**

96. The resistance offered by the wire is 2 ohm per cm.

The radius of the circle = 7 cm.

The circumference of the circle = $2\pi r$ 

$$= 2 \times \frac{22}{7} \times 7 = 44 \text{ cm}$$

 \Rightarrow The length of the wire, $\ell = 44$ cm.The resistance offered by $\frac{\ell}{2}$ i.e., 22 cm is

$$= 22 \times 2 \text{ ohm per cm} = 44 \Omega$$

The above circuit is a parallel combination of two resistors of resistance 44 Ω

The effective resistance of the combination is given by

$$\frac{1}{R_{\text{eff}}} = \frac{1}{44} + \frac{1}{44} = \frac{2}{44} = \frac{1}{22} \Rightarrow R_{\text{eff}} = 22 \Omega$$

This is the maximum resistance, the circle in the circuit can offer.

[Note: The effective resistance of a parallel combination is always less than the least value of resistance in the combination]

Choice (1)

97. Magnetic moment $M = 2 \text{ A m}^2$

Magnetic length $2\ell = 5 \text{ cm} = 5 \times 10^{-2} \text{ m}$.

Magnetic field $B = 0.6 \text{ T}$

$$B = \frac{\text{force}}{\text{pole strength (m)}}$$

$$F = B \times m; M = m \times 2\ell \Rightarrow 2 = m \times 5 \times 10^{-2}$$

$$m = \frac{2 \times 100}{5} = 40 \text{ A m}$$

$$\therefore F = 0.6 \times 40 = 24 \text{ N}$$

Choice (2)

98. I case:

Length of the air column $= 80 - 71 = 9 \text{ cm}$

If 'a' is the area of cross section of the tube, volume of the air column in the barometer tube, $V_1 = (9a)$ units.

Atmospheric pressure $= 76 \text{ cm of mercury}$.

Height of mercury in the barometer $= 71 \text{ cm}$

\therefore the pressure due to air in the barometer tube,
 $P_1 = 76 - 71 = 5 \text{ cm of mercury}$

II case:

Length of the air column $= 80 - 65 = 15 \text{ cm}$

\therefore the volume of the air column $V_2 = (15a)$ units

Let the atmospheric pressure be $x \text{ cm of mercury}$.

\therefore the pressure due to air column $P_2 = (x - 65) \text{ cm of mercury}$. According to Boyle's law, $P_1 V_1 = P_2 V_2$

$$\Rightarrow P_2 = \frac{P_1 V_1}{V_2} = \frac{5 \times 9a}{15a} = 3 \text{ cm}$$

$$\therefore x = 65 + 3 = 68$$

\therefore The actual decrease in the atmospheric pressure
 $= 76 - 68 = 8 \text{ cm of mercury}$.

Choice (4)

99. When the left arm of the manometer is connected to the container of gas X, mercury in the right arm is raised by 2 cm.

\therefore the mercury in the left arm is pushed down by 2 cm and the difference in the mercury level in both the arms $= 4 \text{ cm}$

\therefore the pressure of gas X $=$ atmospheric pressure + pressure due to 4 cm of mercury column $= 80 \text{ cm of Hg}$.

When the right arm is connected to the container of gas Y, mercury in the right arm is pushed down by 5 cm

\therefore The difference in the levels of mercury column in both the arms $= 6 \text{ cm}$.

Thus pressure of Y $=$ pressure of X + pressure due to 6 cm of mercury

$$= 80 \text{ cm of Hg} + 6 \text{ cm of Hg} = 86 \text{ cm of Hg}$$

Choice (4)

100. The frequency of the tuning fork $= 500 \text{ Hz}$.

$$\text{The time taken for one wave to pass} = \frac{1}{500} \text{ s}$$

\therefore Therefore the time taken for 150 vibrations (waves)

$$= \frac{1}{500} \times 150 = 0.3 \text{ s}$$

Hence the distance travelled by sound in 0.3 s is $= 0.3 \times 330$

$$= 99.0 \text{ m}$$

Choice (1)

101. The frequency of fundamental mode of vibration $n_1 = 250 \text{ Hz}$.

The length of air column, $\ell = 33 \text{ cm}$.

Let wavelength of fundamental mode be $= \lambda_1$.

$$\Rightarrow \lambda_1 = 4\ell = 4 \times 33 = 132 \text{ cm}$$

$$\text{We know: } v = n_1 \lambda_1$$

$$= 250 \times 132$$

$$= 33000 \text{ cm s}^{-1} = 330 \text{ ms}^{-1}$$

Choice (2)

102. Only when X emits β -rays, there will be transformation of nucleus. Hence it is no longer an element X.

Choice (3)

103. 150

The zone bit of number is 0101 The numeric bit of the number is the binary equivalent of the numbers.

Therefore the BCD code of 150 is

$$0101000101010101010000$$

Choice (2)

104. Let the mass of water be = m kg.

The heat absorbed by water,

$$Q = ms\Delta t \quad \text{----(1)}$$

$$\Delta t = 50^\circ\text{C};$$

$$s = 4.2 \text{ kJ kg}^{-1}^\circ\text{C}^{-1}$$

The heat released on burning 0.1 kg of LPG

$$= Q = ms \quad \text{-----(2)}$$

Equate (1) and (2)

$$\Rightarrow 0.1 \text{ kg} \times 55,000 \text{ kJ kg}^{-1}$$

$$= m \text{ kg} \times 4.2 \text{ kJ kg}^{-1}^\circ\text{C}^{-1} \times 50^\circ\text{C}$$

$$\Rightarrow m = \frac{0.1 \times 55000}{4.2 \times 50}$$

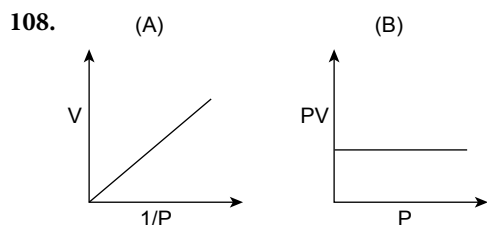
$$= 26.2 \text{ kg} \quad \text{Choice (1)}$$

105. (i) Writing the symbol of positive radical as Cu^{+2}
 (ii) Writing the symbol of negative radical as HSO_4^-
 (iii) Interchanging the valencies of positive and negative radicals and writing 1 and 2 as subscripts.
 (iv) Keeping HSO_4 in paranthesis **Choice (2)**

106. During liquefaction the temperature of the gas should be at or below its critical temperature. During condensation only potential energy decreases, K. E. remains the same and heat is released. **Choice (3)**

107. (c) $\text{C}_2\text{H}_5\text{OH}$ E. F. mass = mol. mass = 46

- (e) CH_3CHO E. F. mass = mol. Mass = 44 **Choice (1)**



Choice (1)

109. The atomic number of the element could be 29 as it corresponds to $[\text{Ar}] 3d^{10} 4s^1$ configuration. The electronic configuration of the element is in violation of Aufbau principle. **Choice (1)**

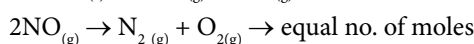
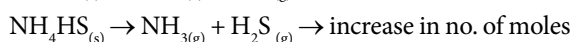
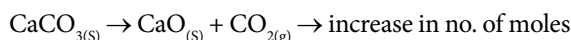
110. The electronic configuration of the atom which becomes stable by losing 2 electrons from the 5th shell and attains an inert gas configuration is 2, 8, 18, 8, 2 and the element is Sr. **Choice (4)**

111. Since the IP value rises abruptly after the 3rd IP, it can be predicted that a trivalent ion is the most stable ion formed by the metal. The formula of chloride is MCl_3 .

Choice (3)

112. In HCl strong H – bond is not there because of the larger size of the chlorine atom. **Choice (4)**

113. $2\text{KClO}_{3(s)} \rightarrow 2\text{KCl}_{(s)} + 3\text{O}_{2(g)} \rightarrow$ increase in no. of moles



Not effected by change in pressure. **Choice (4)**

114. $K_w = 10^{-16}$ for neutral solution $[\text{H}^+] = 10^{-8}$ or $[\text{OH}^-] = 10^{-8}$

For a basic solution $[\text{OH}^-] > [\text{H}^+]$

$[\text{H}^+] < 10^{-8}$ and $[\text{OH}^-] > 10^{-8}$ i.e., 10^{-7} . **Choice (2)**

115. The general formula to represent a carbohydrate is $\text{C}_x(\text{H}_2\text{O})_y$.

Option (1) can be written as $\text{C}_6(\text{H}_2\text{O})_6$

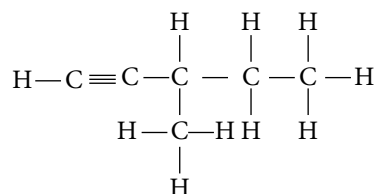
Option (2) can be written as $\text{C}_{12}(\text{H}_2\text{O})_{11}$

Option (3) can be written as $\text{C}_{18}(\text{H}_2\text{O})_{16}$

Option (4) $\text{C}_{20}\text{H}_{40}\text{O}_{18}$ cannot be written in the form of $\text{C}_x(\text{H}_2\text{O})_y$.

Therefore $\text{C}_{20}\text{H}_{40}\text{O}_{18}$ is not a carbohydrate. **Choice (4)**

116. 3 methyl - 1 - pentyne is



The compound has 15 σ bonds and 2 π bonds.

Choice (3)

117. Burning candle is placed in the atmosphere of chlorine continuously burns because it has affinity for hydrogen and hence forms HCl, candle is a hydrocarbon. **Choice (2)**

118. Suberin seen in the wall layer of cork or bark never allows the movement of any gases and water molecules. **Choice (4)**

119. Squamous epithelium is seen in the lining of oesophagus and mouth. Stratified squamous epithelium prevent wear and tear of skin surface. **Choice (1)**
120. Bacteria, cyanobacteria and Mycoplasma are the Moneran members of Eubacterial group. **Choice (3)**
121. All the given statements are correct. **Choice (1)**
122. Staphylococci causes acne and virus causes SARS. **Choice (4)**
123. Immune deficiency in AIDS patients results in various diseases and causes death. **Choice (2)**
124. CO_2 increase in the atmosphere causes an overall increase in the temperature of atmosphere called green house effect. **Choice (4)**
125. Green manure plants are grown and mulched by ploughing them into the cultivating soil. **Choice (1)**
126. Apis mellifera is an Italian bee variety showing maximum honey collection. **Choice (3)**
127. Splitting of water results hydrogen and oxygen in presence of light reaction. **Choice (2)**
128. HCl provides an acidic medium, which is essential for the enzymatic activity of pepsin. **Choice (1)**
129. Haemoglobin shows high affinity to oxygen. **Choice (4)**
130. 140/90 mm Hg is considered as hypertension **Choice (2)**
131. The remainder of X divided by 16 is equal to the remainder when the number formed by the by the last 4 digit of X is divided by 16. We tabulate below the numbers, the number of numbers, the number of digits and the total number of digits in X

Numbers	Number of Numbers	Number of Digits	Total number of Digits
1 – 9	9	9	19
10 – 54	45	90	99
55	Parts of 1 number	1	100

We see that the number formed by the last 4 digits of X is 3545 (The 3 from 53, then 54 and the first 5 from 55) $\text{Rem}(3545/16) = 9$ **Choice (3)**

132. The conjugate of a surd of the form $a \pm \sqrt{b}$ is $a \mp \sqrt{b}$

Hence the conjugate of $16 - 2\sqrt{60}$ is $16 + 2\sqrt{60}$.

$$16 + 2\sqrt{60} = 10 + 6 + 2\sqrt{10 \times 6}$$

$$= (\sqrt{10})^2 + (\sqrt{6})^2 + 2\sqrt{10} \times \sqrt{6} = (\sqrt{10} + \sqrt{6})^2$$

The square root is $\sqrt{10} + \sqrt{6}$. **Choice (1)**

133. The data is tabulated below:

Speed	Time	Distance
u	t	1800 $\Rightarrow ut = 1800$
u – 10	t + 2	1800

$$\therefore ut = (u - 10)(t + 2) = ut + 2u - 10t - 20$$

$$\Rightarrow 2u - 10(1800/u) = 20 \Rightarrow u^2 - 10u - 9000 = 0$$

$$\Rightarrow (u - 100)(u + 90) = 0 \Rightarrow u = 100$$

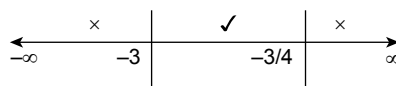
$$\text{and } t = 1800/100 = 18 \quad \textbf{Choice (2)}$$

$$134. \frac{4x^2 - 9x - 9}{x^2 - 9} \leq 0 \Rightarrow \frac{(4x + 3)(x - 3)}{(x - 3)(x + 3)} \leq 0$$

$$x \neq 3; \frac{4x + 3}{x + 3} \leq 0$$

$$(4x + 3)(x + 3) \leq 0$$

$$\text{Critical points are } -3, \frac{-3}{4}$$



When $x = 0$; the inequation is not satisfied

$$\text{Solution set is } (-3, \frac{-3}{4}] \quad \textbf{Choice (1)}$$

135. In a right angled triangle, the length of the median drawn to the hypotenuse is equal to half the hypotenuse.

In $\triangle PQR$, $\angle Q = 90^\circ$. \therefore PR is a hypotenuse.

$$\text{Required length} = \frac{PR}{2}$$

$$PR \text{ (in cm)} = \sqrt{PQ^2 + QR^2}$$

$$\sqrt{5.4^2 + 7.2^2} = \sqrt{((1.8)(3))^2 + ((1.8)(4))^2} = 1.8(5) = 9$$

$$\therefore \frac{PR}{2} = 4.5 \text{ cm.} \quad \textbf{Choice (3)}$$

136. EG : GI = 1 : 3

$$\therefore GH = \frac{1}{4}(IJ) + \frac{3}{4}(EF) = \frac{1}{4}(16) + \frac{3}{4}(12) = 13$$

Choice (2)

137. ABCD is a square of side 14cm

$$\text{Area ABCD} = 196\text{cm} \rightarrow (1)$$

Area of the 2 sectors APD and BPC is equal

$$= 1/2 \times 22/7 \times 7 \times 7 = 77\text{cm}^2$$

$$\text{Area of APD} + \text{Area of BPC} = 154\text{ cm}^2 \rightarrow (2)$$

Area of ABCD – (Area of APD and Area of BPC)

$$= 196 - 154 = 42\text{cm}^2$$

$$\text{Area of shaded portion} = 42/2 = 21\text{ cm}^2 \quad \text{Choice (4)}$$

138. $|x+3|$ and $|x-3|$ always positive for all real values of x

$$\therefore |x+3| + |x-3| > 0$$

$$\therefore f(x) > 0$$

$$\therefore \text{for any value of } x, f(x) > 0$$

$$\therefore \text{number of solutions} = \text{zero} \quad \text{Choice (4)}$$

139. Let shopkeeper have ₹100

$$\text{He buys goods worth : } 1.2 \times 100 = ₹120$$

$$\text{He sells goods worth : } 0.8 \times 100 = ₹80$$

$$\therefore \text{Profit} = \frac{40}{80} \times 100\% = 50\% \quad \text{Choice (3)}$$

140. The difference between the C.I. and S.I. is 120 for 2 years for a principal of ₹12,000

$$\left[p \left(1 + \frac{r}{100} \right)^2 - p \right] - \left[p \left(1 + \frac{2r}{100} \right) - p \right] = 120$$

$$p \left[1 + \frac{r^2}{100} + \frac{2r}{100} - 1 \right] - \left[p \left(\frac{2r}{100} \right) \right] = 120$$

$$p \left[\frac{r^2}{100^2} + \frac{2r}{100} - \frac{2r}{100} \right] = 120$$

$$p \left[\frac{r^2}{100^2} \right] = 120$$

$$\text{But } p = 12000$$

$$12000 \times \frac{r^2}{100 \times 100} = 120$$

$$r^2 = \frac{120 \times 100 \times 100}{12000} = 100$$

$$r = 10\% \text{ p.a.}$$

$$\text{The rate of interest} = 10\%$$

Alternate method:

The different between S.I. and C.I. for two years on sum ₹p at the rate of r% per annum

$$= \frac{pr^2}{100^2}$$

$$\therefore \frac{1200 \times r^2}{100^2} = 120$$

$$r = 10\%$$

Choice (3)

141. Let the series be 4, 4r, 4r², 4r³,

$$\text{Given that, } (4)^3 = \frac{1}{8} \left\{ \frac{4r}{1-r} \right\}^3$$

$$\Rightarrow 4 = \frac{1}{2} \left(\frac{4r}{1-r} \right) \Rightarrow r = 2/3$$

$$\text{The sixth term} = ar^5 = (4) (2/3)^5 = \frac{128}{243} \quad \text{Choice (3)}$$

$$142. A = \begin{pmatrix} 0 & 5 \\ 5 & 0 \end{pmatrix}$$

$$\begin{aligned} A^2 &= A \cdot A = \begin{pmatrix} 0 & 5 \\ 5 & 0 \end{pmatrix} \begin{pmatrix} 0 & 5 \\ 5 & 0 \end{pmatrix} \\ &= \begin{pmatrix} 0+25 & 0+0 \\ 0+0 & 25+0 \end{pmatrix} \\ &= \begin{pmatrix} 25 & 0 \\ 0 & 25 \end{pmatrix} = 25 \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \end{aligned}$$

$$A^2 = 5^2 I$$

$$A^4 = 5^4 I$$

$$\therefore A^{80} = 5^{80} I$$

$$A^{81} = A^{80} A = 5^{80} I \cdot A = 5^{80} A$$

Choice (2)

$$143. \left(2^{1/2} + 3^{1/4} \right)^{64}$$

The first term in the above expansion is

$$T_1 = T_{0+1} = {}^{64}C_0 \left(2^{1/2} \right)^{64} = 2^{32}$$

Which L.C.M. of 2, 4 is 4, since first term is rational, after every 4 terms is again rational i.e., $r = 0, 4, 8, \dots$ 64 are rational terms.

$$64 = 0 + (n - 1) 4$$

$$n - 1 = 16, n = 17$$

\therefore The number of rational terms in the given expansion is 17.

Hence the number of irrational terms

$$= \text{Total terms} - \text{no. of rational terms}$$

$$= 65 - 17 = 48$$

Choice (2)

144. The variance of the series $x_1, x_2, x_3, \dots, x_n$, is p .

\therefore The standard deviation of the series x_1, x_2, \dots, x_n

is \sqrt{p} . The standard deviation of the series $2x_1 + 3, 2x_2 + 3, \dots, 2x_n + 3$ is $2\sqrt{p}$. **Choice (4)**

145. Let the total solution be 100 litres.

	Milk in litres	Water in litres
Initially	90	10
After 1st change	81.0	9.0
After replacement	81.0	19.0
After 2nd change	72.9	17.1
After replacing 10 litres of water	72.9	27.1

If the total capacity is 100 litres, then the quantity of milk left after the procedure = 72.9 litres. If the left over milk is 65.61 litres then the total capacity of the vessel = 90 litres. **Choice (1)**

146. The number of different words that can be formed using all the letters of word TRINETRA is $\frac{8!}{2!2!}$ or 10080. **Choice (4)**

147. Consider five blanks _ _ _ _ _

A word which can read from left to right or right to left it give the same meaning, is known as palindrome.

In a five letter palindrome only first three letters are different and the other two letters are same as first two letters in the respective places.

The first three blanks can be filled in $6 \times 6 \times 6$ ways

\therefore Total number of palindromes possible is 216.

Choice (4)

148. The number of squares in a 8×8 chess board is = 204.

The number of squares of the size 2×2 in a chess board = 49.

\therefore The required probability = $\frac{49}{204}$ **Choice (2)**

149. The slope of the lines $3y + x - 34 = 0$ is $-\frac{1}{3}$

$$\therefore \text{ slope of PQ} = \frac{-1}{-\frac{1}{3}} = 3$$

\therefore The equation of PQ is $y - 4 = 3(x - 2)$ i.e., $y = 3x - 2$

The point of intersection of the lines $y = 3x - 2$ and $3y + x - 34 = 0$ is the mid-point of PQ i.e., (4, 10).

Let Q be (a, b) then

$$\left(\frac{2+a}{2}, \frac{4+b}{2} \right) = (4, 10)$$

$$(a, b) = (6, 16)$$

Choice (1)

150. $(\cot 40^\circ + \cot 50^\circ)(\sec 40^\circ \sec 50^\circ)$

If θ is any angle, then

$$\cot(90^\circ - \theta) = \tan \theta \text{ and } \sec(90^\circ - \theta) = \operatorname{cosec} \theta$$

$$\therefore \text{ required value} = (\cot 40^\circ + \tan 40^\circ)(\sec 40^\circ \operatorname{cosec} 40^\circ)$$

$$= \left(\frac{\cos 40^\circ}{\sin 40^\circ} + \frac{\sin 40^\circ}{\cos 40^\circ} \right) \left(\frac{1}{\cos 40^\circ} \frac{1}{\sin 40^\circ} \right)$$

$$= \frac{(\cos 40^\circ)^2 + (\sin 40^\circ)^2}{(\cos 40^\circ \sin 40^\circ)^2}$$

$$= \frac{1}{\left(\frac{2 \cos 40^\circ \sin 40^\circ}{2} \right)^2}$$

$$= \frac{1}{\left(\frac{\sin 80^\circ}{2} \right)^2}$$

$$= \frac{4}{\sin^2 80^\circ}$$

Choice (3)